PHASE I RECONNAISSANCE SITE CHARACTERIZATION REPORT FOR THE SILVER CREEK DRAINAGE PROJECT

Lewis & Clark County, Montana

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1.0 INTRODUCTION

This document was prepared for the Montana Department of Environmental Quality/Mine Waste Cleanup Bureau (DEQ/MWCB) by Olympus Technical Services, Inc. (Olympus) under DEQ Contract No. 401026. This report presents the results of the Phase I Reconnaissance Site Characterization of the Silver Creek drainage basin completed by Olympus.

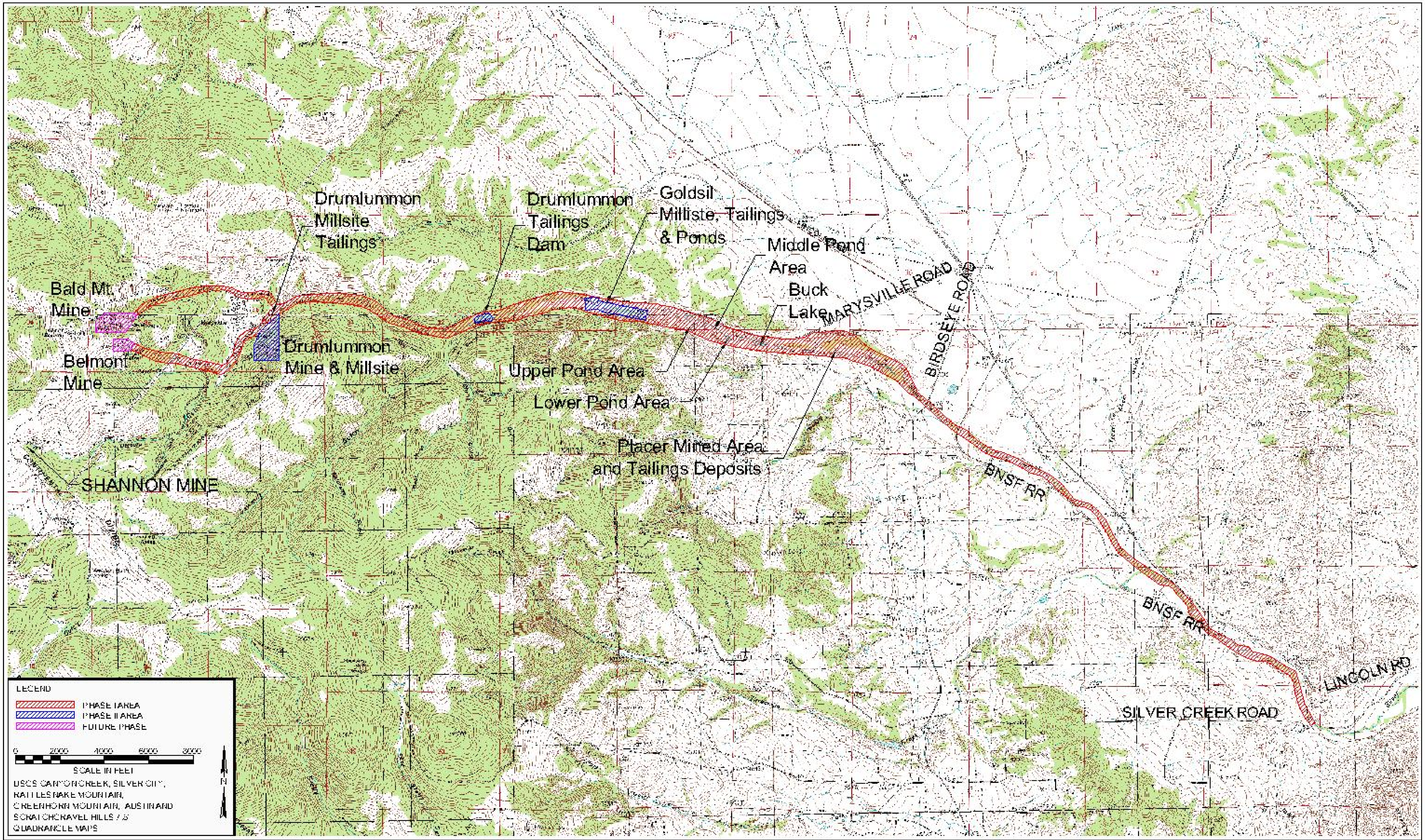
The project was completed according to the sampling approach for the Silver Creek Drainage Project Phase I Reconnaissance Site Characterization as described in the Phase I Field Sampling Plan (FSP, MWCB/Olympus, 2002a), which contains the Standard Operating Procedures (SOPs) for conducting the field sampling activities. Supporting documents for the Phase I FSP include the Quality Assurance Project Plan (QAPjP) that describes quality assurance procedures for the field and laboratory data for the project (DEQ-MWCB/Olympus, 2002e), the Health and Safety Plan that describes practices and procedures to minimize exposure to hazardous materials and to reduce the possibility of physical injury (DEQ-MWCB/Olympus, 2002c), and the Laboratory Analytical Plan (DEQ-MWCB/Olympus, 2002d). In addition to the Phase I Reconnaissance Site Characterization, Olympus also completed a Phase II Detailed Site Characterization the Drumlummon Mine and Millsite and the Goldsil Millsite, which are located in the Silver Creek drainage (MWCB/Olympus 2003).

1.1 PROJECT DESCRIPTION

The Silver Creek Drainage Project is located approximately 15 miles north of Helena, Montana. The headwaters of the basin are located on the east side of the Continental Divide near the historic mining community of Marysville and the project encompasses a portion of the Marysville Mining District.

The project area is located in Lewis & Clark County, Montana within Sections 35 and 36, Township 12 North and Range 6 West; Sections 31, 32, 33 and 34, Township 12 North, Range 5 West; Sections 1, 2, 3 and 5, Township 11 North, Range 5 West; and Sections 6, 7, 8, 16, 17, and 21, Township 11 North, Range 4 West, Montana Principal Meridian (Figure 1-1). This figure shows the approximate boundaries of the project and the location of Phases I and II of the characterization. Figure 1-2 is a composite of aerial photographs taken in 1995 showing an overview of the Silver Creek Drainage Project area. More detailed aerial photographs are presented to show the Marysville and Drumlummon Mine areas (Figure 1-3), Silver Creek above Sawmill Gulch (Figure 1-4), Drumlummon and Goldsil tailings areas (Figure 1-5), the Goldsil Millsite and Upper, Lower and Middle Pond Areas (Figure 1-6), the Buck Lake and the upper Silver Creek placer tailings areas (Figure 1-7), the lower Silver Creek placer tailings area (Figure 1-8), Silver Creek Below Birdseye Road (Figure 1-9), Silver Creek through the upper portion of the Gehring Property (Figure 1-10), Silver Creek through the lower portion of the Gehring Property (Figure 1-11) and lower Silver Creek near Silver Creek Road (Figure 1-12).

The site is accessed by proceeding north on Interstate 15 from Helena approximately 8.2 miles to Exit 200, proceeding west on Highway 278 (Lincoln Road) for approximately 9.5 miles and turning left (west) onto Marysville Road. The Marysville Road runs along Silver Creek for approximately 5 miles. The lower portion of the project area can be accessed by turning off of Lincoln Road onto the Silver Creek Road. The downstream project boundary is located where the Burlington Northern & Santa Fe Railway intersects Silver Creek Road.



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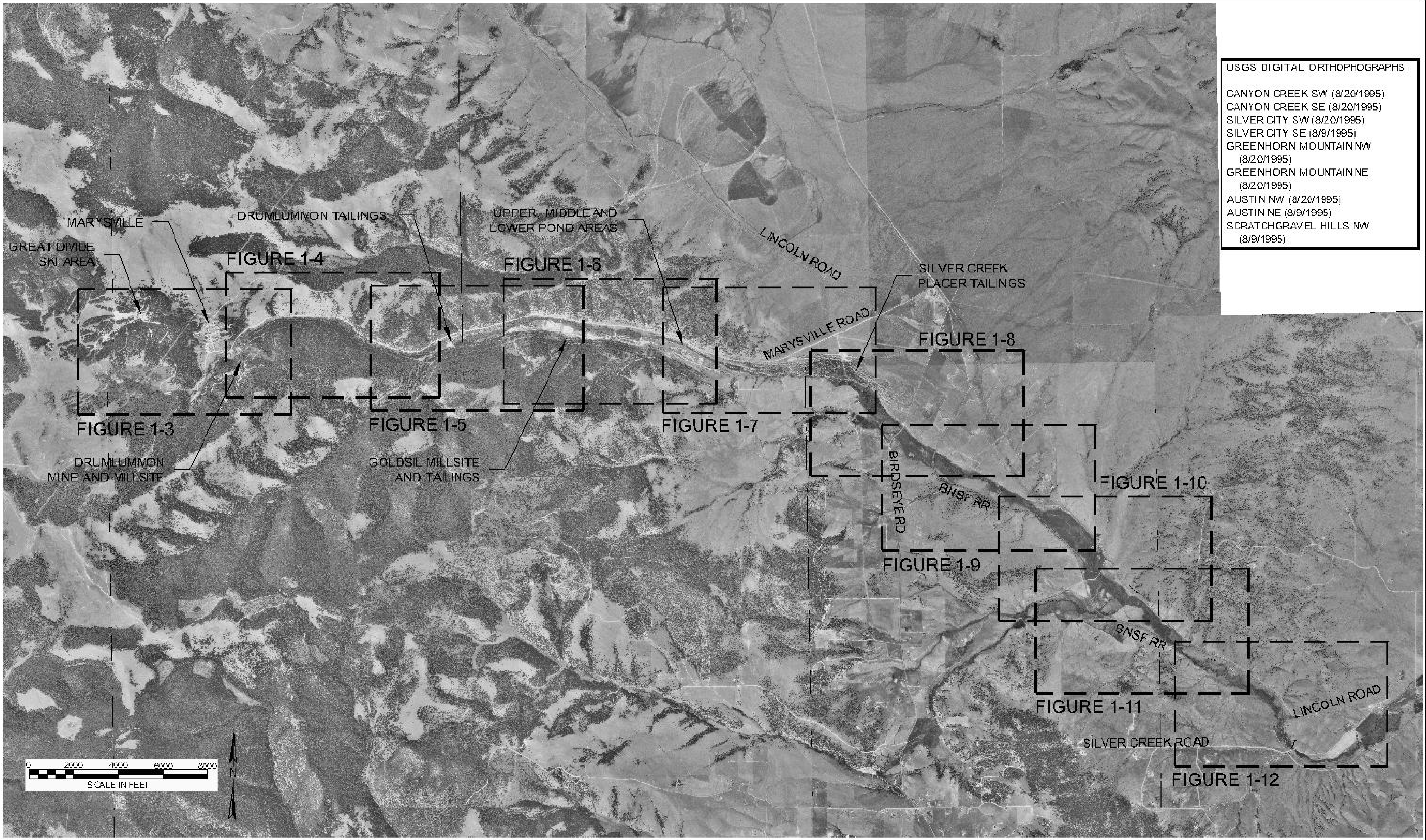

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SILVER CREEK DRAINAGE CHARACTERIZATION
LEWIS & CLARK COUNTY, MONTANA

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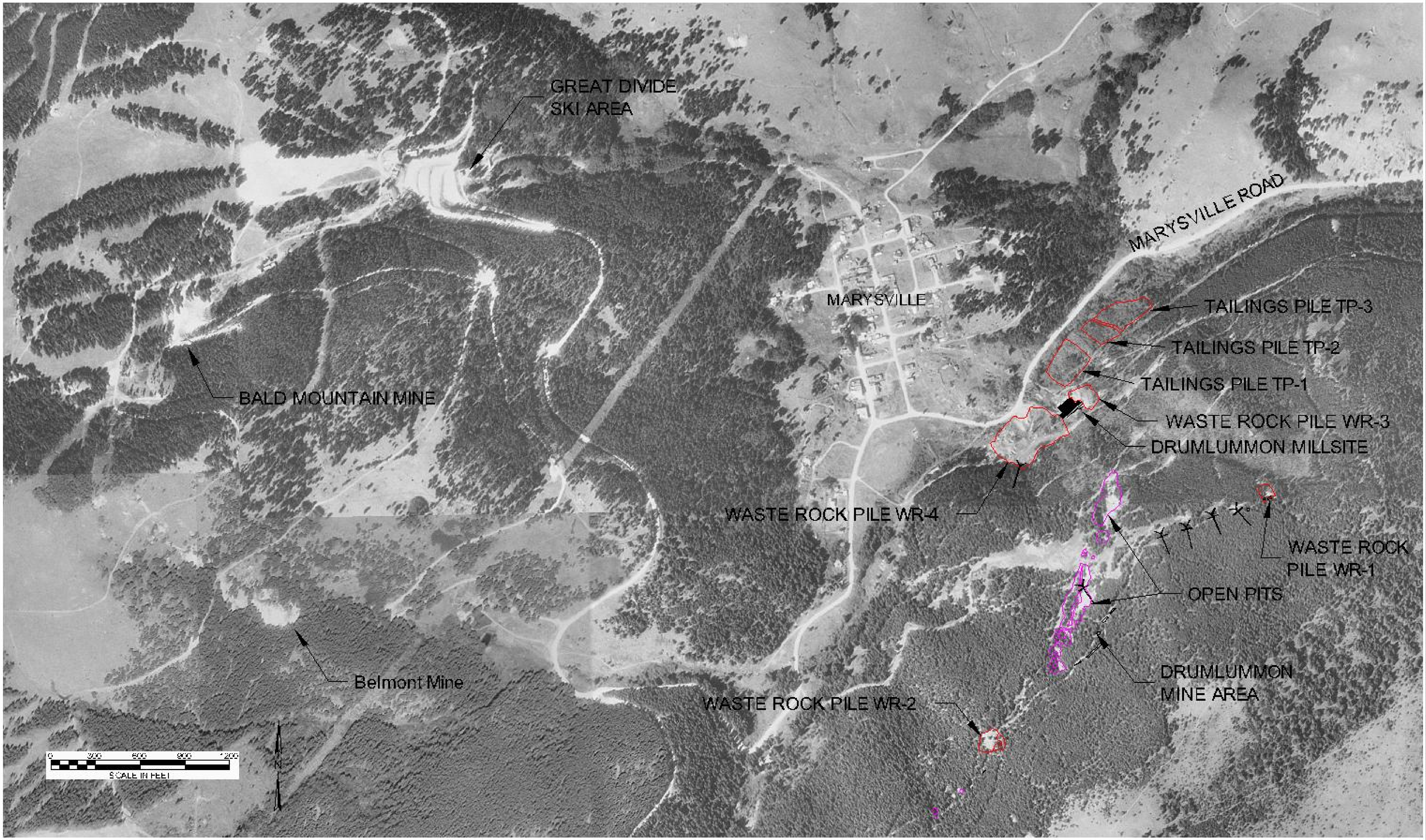
AERIAL PHOTOGRAPH OF THE SILVER CREEK DRAINAGE

FIGURE 1-2



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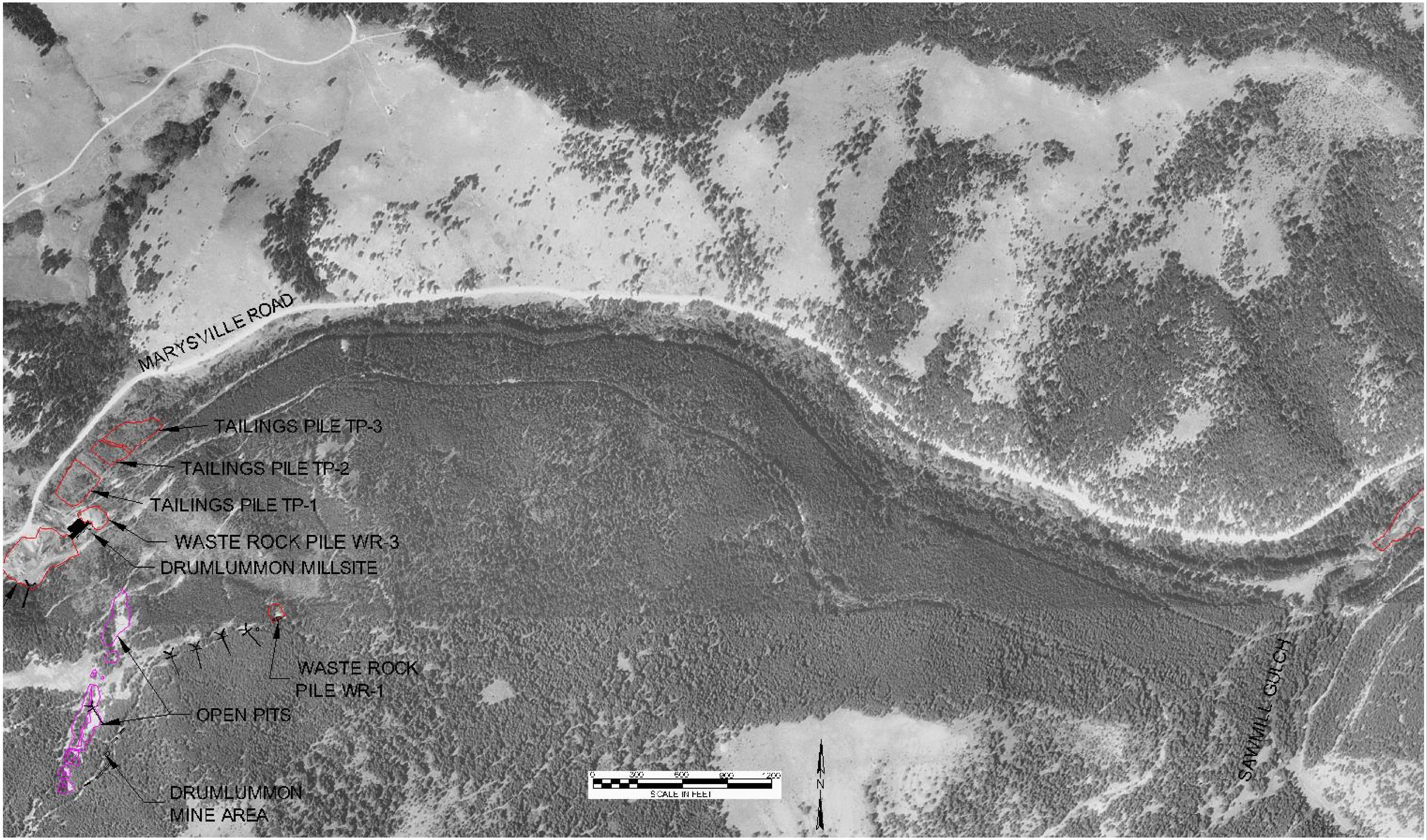
MARYSVILLE AND
DRUMLUMMON MINE AREA

FIGURE
1-3



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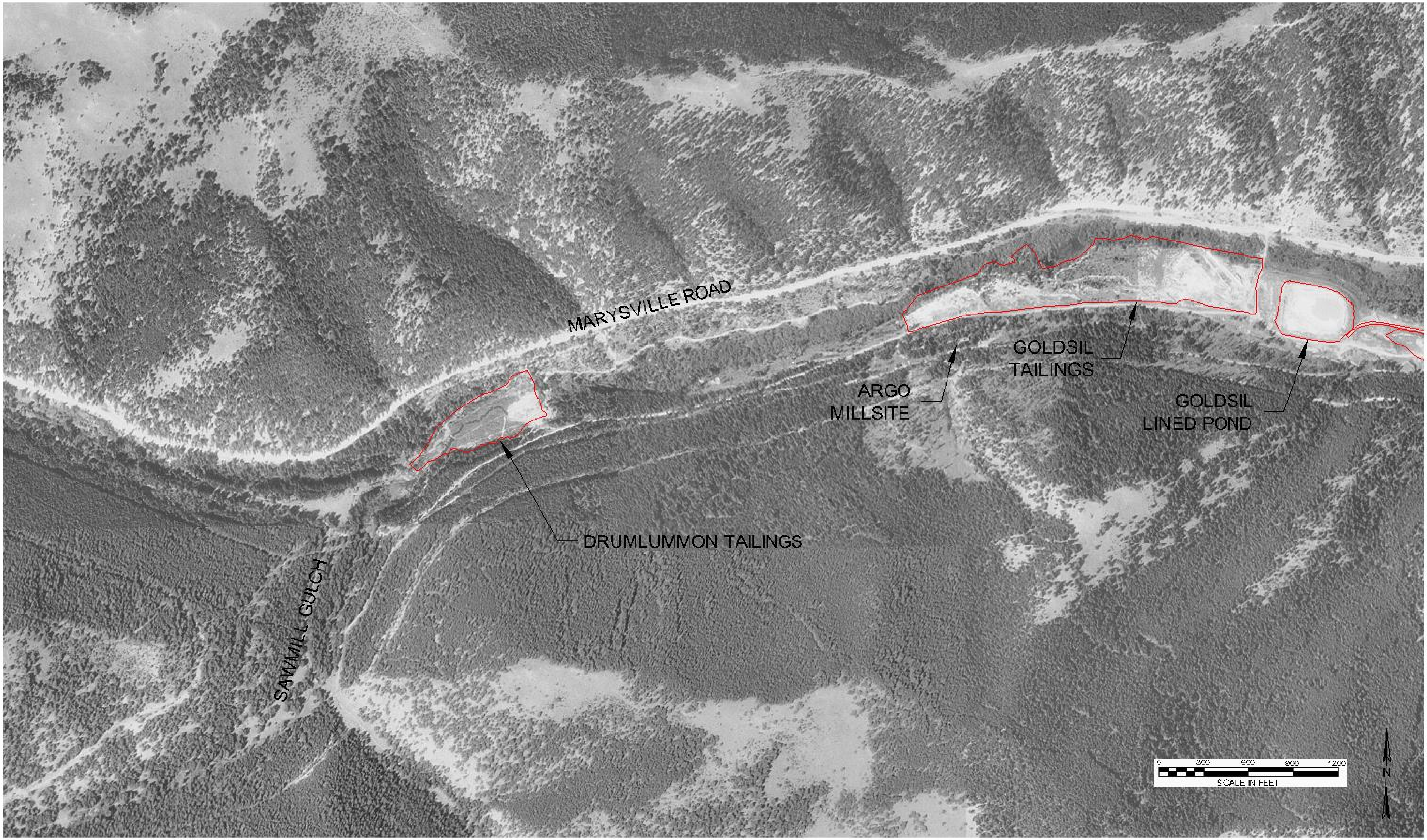
SILVER CREEK ABOVE
SAWMILL GULCH

FIGURE
1-4



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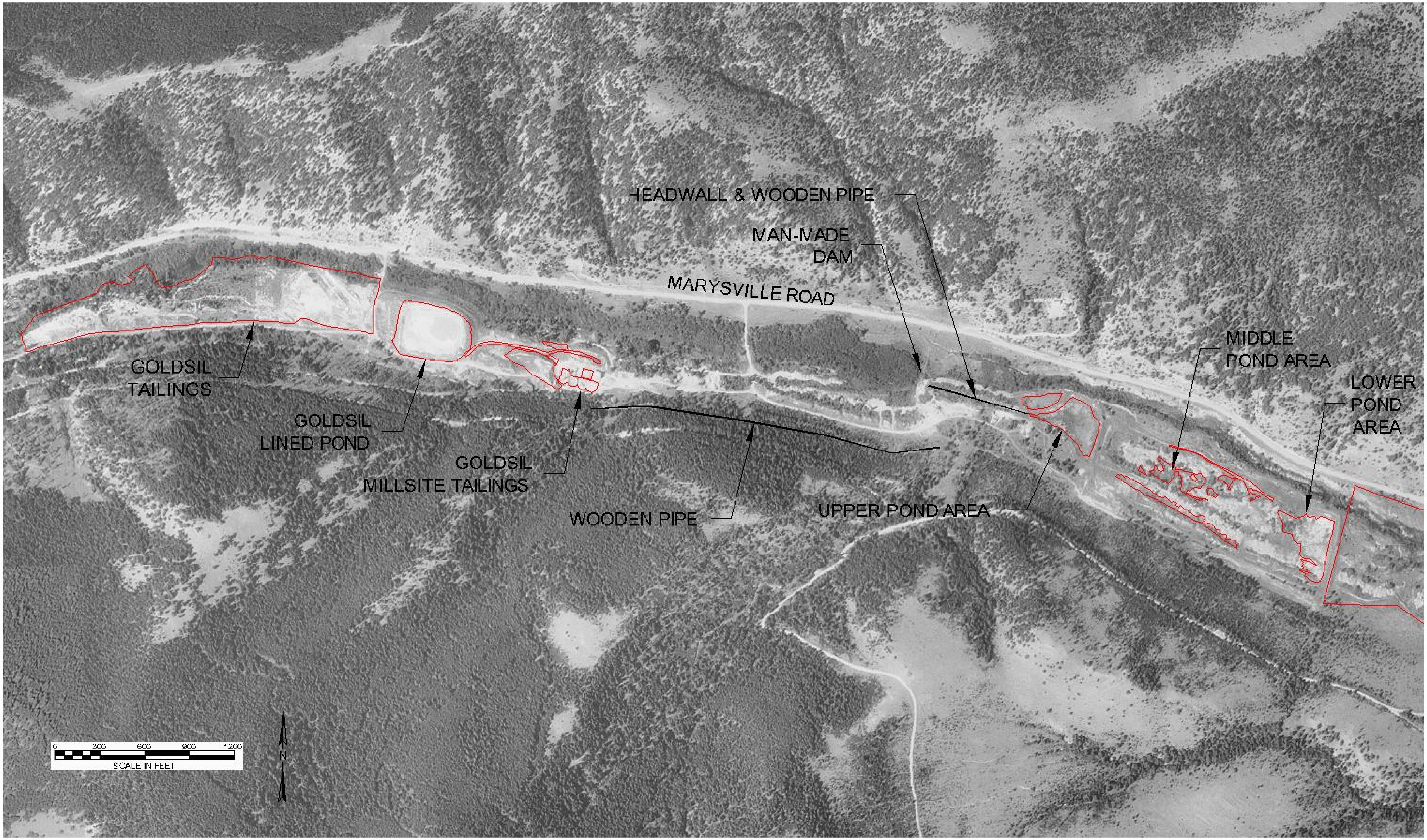

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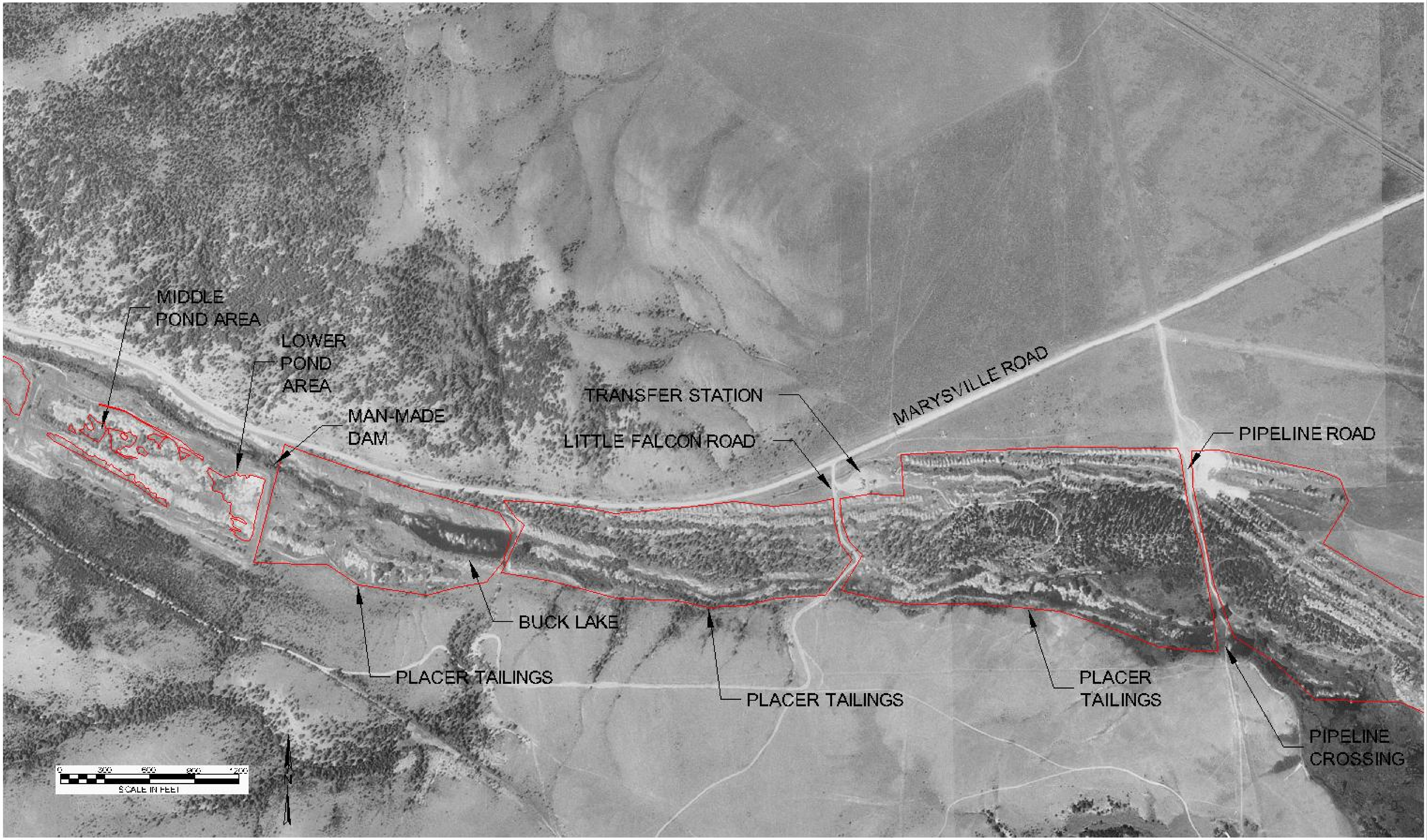
GOLDSIL AND UPPER, MIDDLE AND LOWER POND AREAS

FIGURE 1-6



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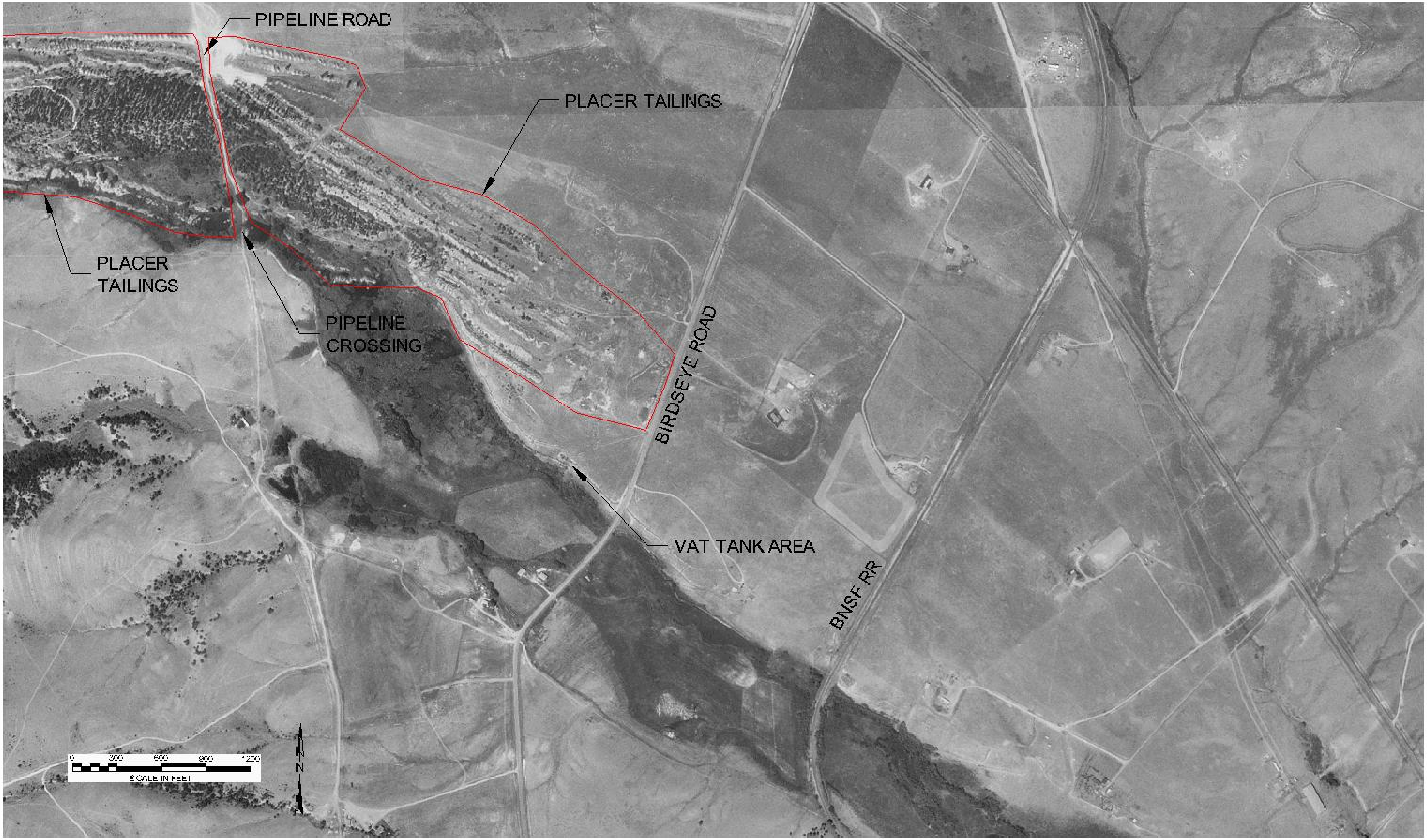
BUCK LAKE AND SILVER CREEK PLACER TAILINGS

FIGURE 1-7



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LOWER SILVER CREEK
PLACER TAILINGS

FIGURE
1-8

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SILVER CREEK BELOW BIRDSEYE ROAD

FIGURE 1-9

				DESIGN:	DRAWN: KSR	CHECKED: CRS	MONTANA DEQ/MINE WASTE CLEANUP BUREAU SILVER CREEK DRAINAGE CHARACTERIZATION LEWIS & CLARK COUNTY, MONTANA	Olympus Technical Services, Inc.	SILVER CREEK THROUGH THE UPPER PORTION OF THE GEHRING PROPERTY	FIGURE 1-10
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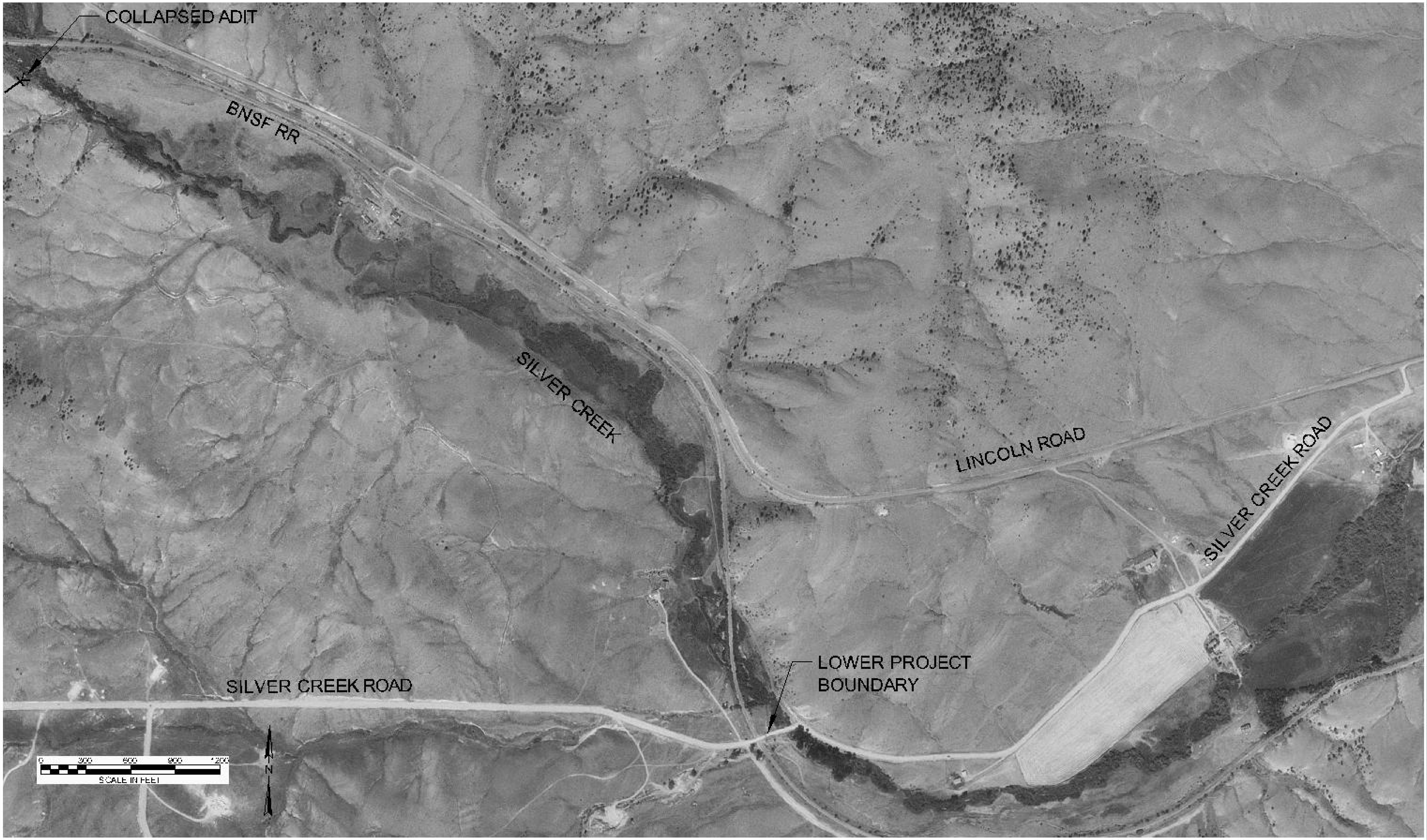
SILVER CREEK THROUGH THE LOWER PORTION OF THE GEHRING PROPERTY

FIGURE 1-11



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LEWIS & CLARK COUNTY, MONTANA

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LOWER SILVER CREEK AND SILVER CREEK ROAD

FIGURE 1-12

The Silver Creek Drainage Project area is located on patented mining claims, public land and private land. The site is comprised of the Silver Creek streambed, banks and floodplain, Jennies Fork (a tributary in the upper reach of Silver Creek, below the Belmont Mine), several abandoned mine sites and associated waste piles and a large area of placer mine tailing piles.

1.2 PROJECT OBJECTIVES

The objective of the reconnaissance site characterization is to provide a preliminary assessment of the entire length of the project area (approximately 14 miles). This reconnaissance includes the Silver Creek streambed, streambanks and floodplain area (excluding the known waste sources at the Bald Mountain, Belmont and Drumlummon mines and the Drumlummon and Goldsil tailings piles), the Jennies Fork streambed, streambanks and floodplain, and the large area of placer tailings upstream from Birdseye Road.

The known waste sources at the Drumlummon mine and the Drumlummon and Goldsil tailings piles have been characterized as part of Phase II of the Silver Creek Drainage Project. Known waste sources from the Bald Mountain and Belmont mines will be characterized during a future work phase. Surface water quality in Silver Creek has been evaluated in previous studies; thus, no surface water sample collection was completed for the reconnaissance characterization.

2.0 BACKGROUND INFORMATION

2.1 MINING HISTORY

The historic name of the Marysville mining district is the Ottawa mining district. The only town in the region, Marysville, is about 18 miles northwest of Helena. Silver Creek, which begins just above Marysville, runs eastward 16 miles before discharging into Lake Helena. The gold-bearing gravels found in Silver Creek for four miles below the town were first discovered in 1862, but the richer bars were not worked until May of 1864. The pay streak was from 30 to 50 feet wide and gold was found on the bedrock 15 to 20 feet from the surface. The gold was valued at only $14 per ounce (as opposed to $17 gold from Last Chance Gulch) due to its high silver content. The stream was worked by hydraulicking, and the side bars in the gulch were said to have paid well. While no production figures are available for the early years and from 1870 to 1880, in 1869 the stream produced $50,000. Later in the 1880s, the district produced from $9,000 to $15,000 in placer gold. The stream has been estimated to have produced a total of $3,000,000 (Pardee and Schrader, 1933; Goodale, 1915; Axline, 1991).

Placer mining activities in the drainage occurred at various time periods. Approximately 75% of the activity was on Silver Creek, with the remaining activity on tributaries. Placer activity was reported to be sporadically active from the 1860s through 1921. Gold production through this time period is reported at $3.2 million (Lyden, 1987). Other periods of placer mining activity were in 1933 and from 1937 to 1941. During the period 1937 to 1941, a dragline dredge worked on bench and creek placers from the Silver City-Seven Mile Creek county road (Birdseye Road) upstream to within a short distance of the lowermost of several old tailings ponds, a distance of approximately 2 miles. Approximately 1,000,000 cubic yards of material were processed in this stream reach as a result of the dredging activity (Lyden, 1987). Although it is not known what separation processes were used in this operation, mercury was historically used as an amalgam to remove gold and silver from the black sand concentrates recovered by the dredges.

Hardrock mining in the drainage began about 1875 with the discovery of the lode gold deposits of the Drumlummon Mine by Thomas Cruse. Major metal commodities were gold, silver, zinc, lead, and copper. The period of greatest prosperity for the area was from 1875 to 1921 (Lyden, 1987). The major hardrock mines in the Silver Creek drainage basin include the Drumlummon, Belmont, Bald Mountain, and Shannon mines. These mines, together with several other mines on the west side of the Continental Divide, likely produced over 30 million dollars of gold from 1875 through 1913 (Knoph, 1913). The mine workings in the headwaters area consist of numerous adits, small trenches and pits with associated waste rock dumps. Some of the workings are located high on the Continental Divide ridge line above the gulches on very steep terrain.

The lode mineral deposits in the Marysville Mining District are veins which have been categorized into the Drumlummon type and the Towsley Gulch type (McClernan, 1983). The Drumlummon type consists of platey calcite gangue and gold with minor sulfides, including tetrahedrite, chalcopyrite, pyrite, sphalertite, and galena. Manganese staining is prevalent in the ore, which occurs in shoots through the veins. The highest grade ore reportedly occurred near the surface in these veins, likely due to supergene enrichment. The Towsley Gulch type of veins are typified by more abundant sulfides with significant silver and lead values. These veins also contain abundant rounded fragments of country rock resembling a sedimentary conglomerate.

Mill production records for the various mine sites were reported by McClernan (1983). For the period of 1909 to 1948, total production for the combined Drumlummon, Belmont, and Bald Mountain mines was approximately 25,000 ounces of gold and 61,000 ounces of silver from 118,000 tons of ore. For the period of 1901 to 1948, production from the Drumlummon Mill was approximately 116,000 ounces of gold and 853,000 ounces of silver from 480,000 tons of ore. Additional ore from the Drumlummon Mine was likely processed at the Drumlummon Mill during the period from 1875 to 1900, although no records are available.

A mill was constructed in the mid 1970s east of Marysville by John White reportedly for the purpose of reprocessing mill tailings material. Operations at this mill were shut down in 1976 following reports of a fish kill in Silver Creek and an investigation by the Montana Department of Fish, Wildlife, and Parks (MDFWP). The mill was purchased in the late 1970s by Goldsil Ranchers Company and reportedly operated for a short time during the summer of 1980 until a fire and another reported seepage from the lower tailings pond caused mill operations to cease. The following timeline was constructed by Maxim Technologies, Inc. (DEQ-AMRB/Maxim,1996) from DEQ Water Quality Bureau files:

Mid 1970s	White Mill Constructed
February 1976	Fish kill reported below mill
October 1976	High cyanide and metals concentrations measured in a mill pond, low cyanide and metals concentrations measured in Silver Creek by MDFWP during investigation of fish kills
September 1980	>68 dead fish counted by WQB below mill
September 1981	Consent Decree, District Court, Goldsil fined $5,000 and pays $4,755 agency costs

January 5, 1983	Hydrometrics investigation of mercury and cyanide in Silver Creek completed
October 31, 1983	Release of water to Silver Creek from new pond upstream of mill reported
February 31, 1984	Goldsil submits mine permit application to Department of State Lands
July 7, 1984	Goldsil submits response to comments to Department of State Lands
March 7-19, 1986	Tailings pond at mill in danger of overflowing, pumped down
July 9, 1986	Dead cows reported near mill, mill fenced off to cows

Currently the mill building is torn down and no mining or milling activities are known to be active in the drainage basin.

2.2 CLIMATE

There are no official weather stations in the Silver Creek drainage. There are two weather stations within generally an 8-mile radius around the Silver Creek drainage. National Oceanic and Atmospheric Administration's Western Regional Climate Center has compiled temperature and precipitation data at Canyon Creek (241450), Montana and Austin (240375), Montana for the periods May 6, 1907 through March 31, 1979 and April 12, 1950 through December 31, 2001, respectively. These appear to be the closest official weather stations to the Silver Creek drainage. Canyon Creek and Austin are approximately 4 miles northeast and 8 miles south of Marysville, respectively. The average annual maximum and minimum temperatures recorded at the Austin site were 53.6 degrees Fahrenheit (°F) and 29.6° F. Temperature data were not reported for the Canyon Creek site. The average annual total precipitation for the Canyon Creek and Austin sites is 10.82 and 16.15 inches, respectively. The lowest and highest average precipitation occurs in the months of February/March and May/June, respectively. Average annual total snowfall is 43.2 inches and 59.9 inches for Canyon Creek and Austin, respectively. Most snow falls from December through April.

Like most of southwestern Montana, the Silver Creek drainage is subject to a cool and dry continental-dominated climate. The temperature of the region is marked by wide seasonal and daily variations. During winter, the temperature can fall lower than 30 degrees below zero Fahrenheit (°F). During summer, many days reach the 80's and 90's but due to the generally arid climate and lightness of the mountain air, the temperature can drop substantially at nightfall. Precipitation in the basin averages 30 inches annually at Marysville (U.S. Soil Conservation Service, 1974). Approximately half of the annual precipitation falls as snow during winter (90 inches average annual snowfall). Stormy weather usually brings the first snow during September, however, these "equinoctial storms" are generally succeeded by several weeks of fair weather. By November, the area is usually blanketed with snow. Heavy snows are frequent in the winter as are periods of melting and freezing which occur as a result of warm Chinook winds that occasionally blow from the west. The snowpack generally remains in the area for six months or longer, with spring thaw occurring in April or May (NOAA, 1988).

The area is subject to a distinct spring/summer rainy season with May or June usually being the wettest month of the year. On average, May and June each receive 3.5 inches of precipitation.

The frost-free period (32° F or more) averages approximately 70 days annually, from mid-June to late August (NOAA, 1988).

2.3 GEOLOGY, HYDROGEOLOGY, AND HYDROLOGY

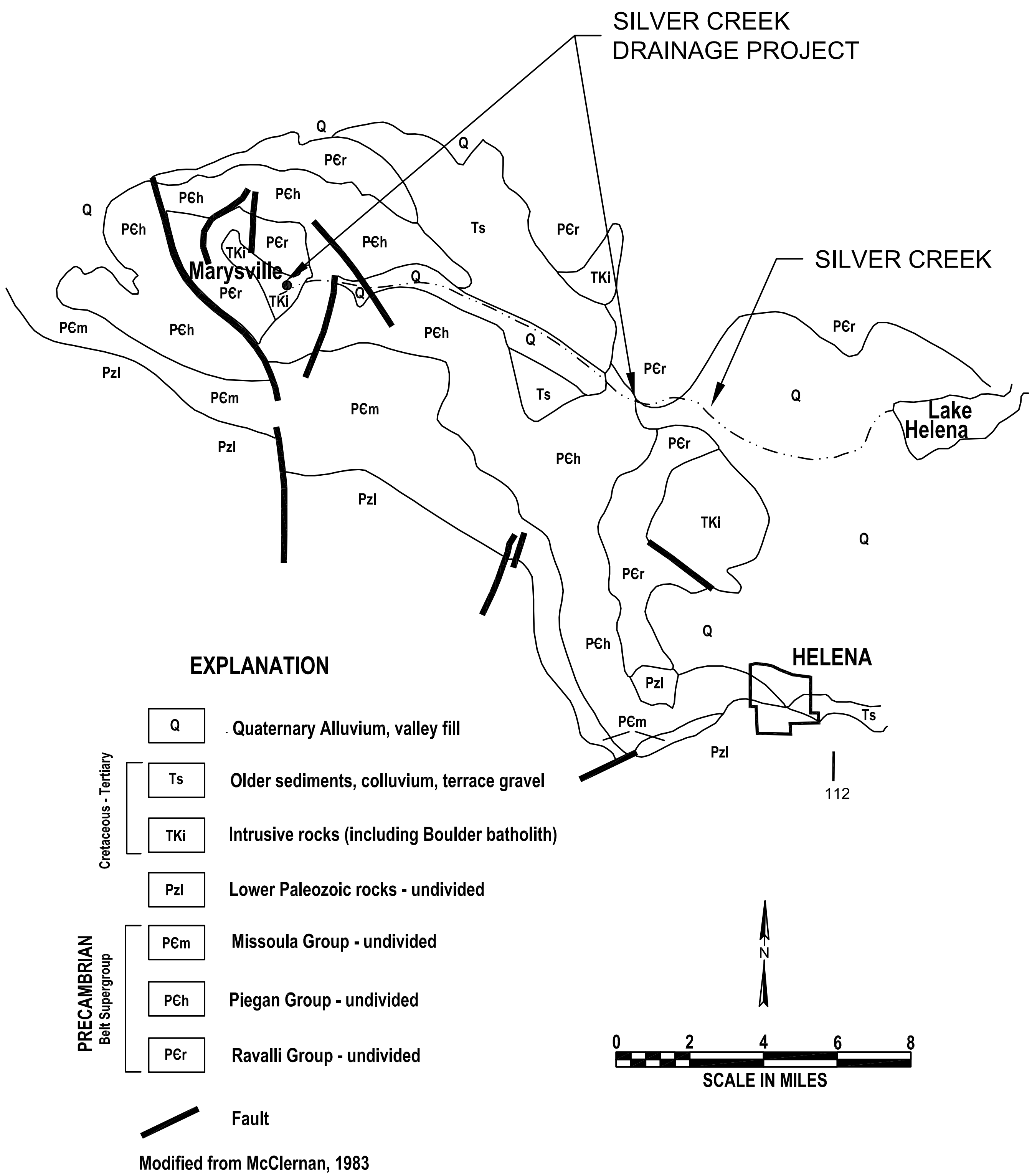
2.3.1 Local and Regional Geology

A significant portion of the Silver Creek Drainage Project is located within the general area of the Marysville mining district, located near the continental divide in Lewis & Clark County. The stratigraphy of the area comprises units of the Precambrian Belt Supergroup, hosting a contact metamorphic zone surrounding a series of Cretaceous and Tertiary intrusives. Structurally, the Marysville mining district is located near the eastern terminus of the Lewis and Clark line, a zone of east-west trending, right lateral strike-slip faults which appear to have been intermittently active since middle Proterozoic with an active stage between 82 and 45 million years ago (Ma) (Walker, 1992). The major evidence of this faulting in the Marysville area is a series of faults near Bald Butte. Additional structure in the area is represented by a slight doming of the metasedimentary units around the major intrusive body.

A generalized geologic map for the Silver Creek drainage area is presented in Figure 2-1. The stratigraphy of the major units in the area is summarized from Walker (1992). The two principal Precambrian units in the area are the Empire and Helena Formations (Knopf, 1913). The oldest formation exposed is the Empire Formation (Ravalli Group), characterized as a compact, locally calcareous, light to dark, greenish gray shale. Near Marysville, the shales have been metamorphosed to a fine-grained, light to dark green, gray or black hornfels banded green and purple. Overlying the Empire Formation hornfels is the Helena Formation (Piegan Group), generally a siliceous limestone, with some dolomite also present.

The oldest igneous rocks present are probably Precambrian microdiorite sills randomly distributed within the Empire and Helena Formations throughout the area. The sills are generally dark brown to black, less than three feet thick and often appear as swarms with multiple bands emplaced along bedding. The primary igneous unit, which forms the Marysville Stock, is a quartz diorite intruded at approximately 79 Ma. The surface exposure of the unit is irregular, with the main body located near the town of Marysville with an elongate extension to the Gloster mine area. A series of three porphyries of intermediate composition, and two hornblende diorite dikes, are also present within the western portion of the Marysville Mining district. At approximately 49 Ma, a rhyolite quartz porphyry intrusion occurred in the Bald Butte area, which was later intruded by a series of quartz porphyry sills and dikes between 37 to 40 Ma. The youngest igneous event in the mining district is a Tertiary rhyolite extrusive, dated at 37 Ma, occurring in limited exposures in the southwest portion of the Marysville mining district.

The Marysville mining district economic mineral deposits were contained in both placer and lode deposits. The gold and silver placer deposits are contained within unconsolidated alluvium in and around Silver Creek. Although gold and silver were the primary commodities in the lode deposits, lesser base metals including lead, zinc and copper were also produced. Gold occurred mostly as free gold, although there may have been some gold associated with pyrite at the Drumlummon and Gloster mines. Silver was associated with the gold and also occurred in other mineral phases including acanthite, tetrahedrite, and pearceite. The epigenetic and epithermal precious metal deposits occur in vein deposits hosted within the metasedimentary rocks near the contact zone with the quartz diorite of the Marysville stock. The veins are



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GENERALIZED GEOLOGIC MAP
SILVER CREEK DRAINAGE PROJECT
Lewis & Clark County, Montana

FIGURE
2-1

composed of varying amounts of quartz, carbonate and adularia gangue along with precious metals. The mining history indicates that sulfides typically increased with depth in the vein systems and sulfides included one or more of the following minerals: pyrite, chalcopyrite, galena and sphalerite. In areas known to have younger silicic intrustives at depth (i.e., Bald Butte and Empire Creek) veins are known to contain fluorite and molybdenite in addition to the normal epithermal mineral suite. Hydrothermal alteration differs on veins throughout the district. Alteration types include minor bleaching and kaolinization, silicification, and potassic alteration manifested by the intense development of biotite and orthoclase.

2.3.2 Hydrogeology

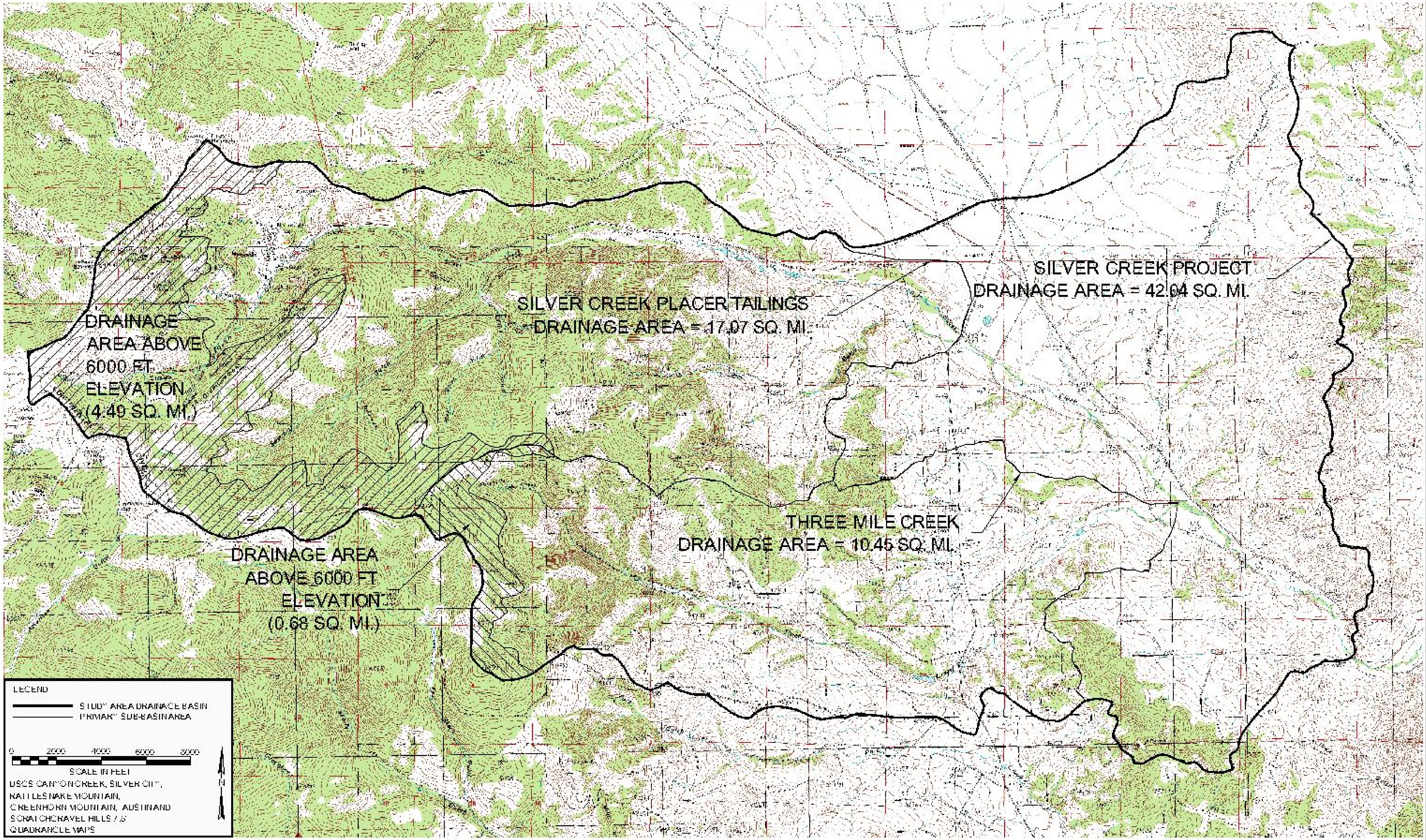
Hydrogeologic information specific to the Silver Creek area include a permit application for Goldsil Mining and Milling, Inc. prepared by Hydrometrics and submitted to the Montana Department of State Lands in 1984 (Goldsil Mining and Milling, 1984a). The following general observations on the hydrogeologic setting are based on information in this application as well as accepted hydrologic and geologic principles and local observations.

The Silver Creek drainage basin is comprised of a headwaters area near the town of Marysville and several major tributaries flowing from the south. The hydrogeologic system contains two main components; bedrock and alluvial valley fill. The bedrock is moderately fractured and contains vein structures associated with the intrusion of the stock. Numerous fractures are present in the bedrock, including bedding structures, joints and faults associated with the tectonic history, and vein structures. The dolomite of the Helena Formation could also contain secondary groundwater flow pathways due to solution of the dolomite by groundwater. Due to the complex and unpredictable nature of the bedrock structures, it is likely that the rate and direction of groundwater flow is widely variable over short distances. Permeability and transmissivity of the bedrock aquifer system probably vary widely. The alluvial deposits are thin, shallow, and discontinuous and likely transmit both surface water from local streams and discharging bedrock groundwater.

Groundwater flow likely follows local stream gradients and topography, with groundwater discharging to gaining alluvial streams which is typical of high mountain drainage systems. However, local bedrock fault systems and secondary solution features probably exert significant control on the direction and rate of groundwater flow, as do the underground workings associated with the mines in the area.

2.3.3 Surface Water Hydrology

Surface hydrology in the Silver Creek drainage basin consists of Silver Creek and several perennial and intermittent gulches. Figure 2-2 shows the drainage area of the Silver Creek Drainage Project. In the upper reaches, Silver Creek is formed by the confluence of surface water flow from Ottawa and Rawhide gulches above the town of Marysville. Jennies Fork, which drains the area northwest of Marysville, enters Silver Creek from the north immediately downstream of Marysville. Other major tributaries to Silver Creek downstream from Marysville include Sawmill Gulch, Sitzer Gulch, and Threemile Creek, all entering from the south (Figure 2-2). No significant mining activity is known to have been performed in any of these three tributary drainages.



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				APPROVED:	DATE: 5/2002	JOB NO: A1221				
				SCALE: AS SHOWN	FILENAME: A1221FSP.dwg					

Contributions to surface water flow in the headwaters of Silver Creek also include the discharges from several abandoned mines. Adit discharges have been documented from the Shannon Mine, Bald Mountain Mine, Belmont Mine, and the Drumlummon Mine (DEQ-AMRB/Maxim, 1996). Discharges from abandoned adits associated with the Bald Mountain and Belmont mine were sampled during the spring of 1996 prior to reclamation work on these discharges (DEQ-AMRB/Maxim, 1996).

The hydrology of the headwaters area of Silver Creek above Marysville has been slightly affected by mine adits and by mine waste rock piles. Severe effects to the stream hydrology by placer mining and deposition of mill wastes are present from Marysville to the Birdseye road. The majority of the valley bottom and flood plain in this lower reach has been placer mined and several mill tailings ponds are located in the floodplain. A tailings dam associated with the Drumlummon Mill is located in Silver Creek approximately 1.5 miles downstream from Marysville. This tailings dam failed during high flows which occurred in the spring of 1992 and was repaired by a Water Quality Bureau contractor in 1994 by placing riprap along two channels which convey Silver Creek through the breached dam.

Several other tailings dams and ponds have been constructed in old placer tailings material downstream of the breached tailings dam. These ponds are located in dredge tailings on the south bank of Silver Creek and were associated with a mill constructed by John White in the 1970s. This mill was also operated by the Goldsil Mining Company during the 1980s.

There are no records for stream gaging stations on Silver Creek. A gaging station was operated on Little Prickly Pear Creek near Marysville from 1913 through 1932. Little Prickly Pear Creek is the drainage directly north of Marysville. The gaging station has a reported drainage area of 44.40 square miles and a gage datum of 4,700 feet above sea level. Omang (1992) reports flood frequency data at the Little Prickly Pear gaging station based on the data for the period of record as shown in Table 2-1.

A procedure developed by Omang (1992) that uses the drainage-area ratio of an ungaged site to that of a gaged site was used to estimate the magnitude and frequency of floods for the Silver Creek drainage for the project area. This method is valid for drainage areas that are between 0.5 and 1.5 times the area of the gaged drainage area. The Silver Creek Drainage Project covers an area of 42.04 square miles, which is 94.7 percent of the gaged drainage area. The peak discharges for the Silver Creek drainage estimated by drainage-area ratios are shown in Table 2-2.

TABLE 2-1 PEAK DISCHARGE FOR LITTLE PRICKLY PEAR CREEK NEAR MARYSVILLE (OMANG, 1992)

Recurrence Interval (years)	Peak Discharge (cfs)
2	141
5	255
10	354
25	510
50	650
100	813

Peak discharge for Silver Creek was also estimated using regional flood-frequency equations developed by Omang (1992). The regional equations for southwest Montana use the drainage basin area (42.04 square miles) and the percentage of the basin area above 6,000 feet in elevation (12.3 percent) to estimate peak discharge. Peak discharges estimated by regional flood-frequency equations for the Silver Creek drainage are shown in Table 2-2.

TABLE 2-2 ESTIMATES OF PEAK DISCHARGE FOR THE SILVER CREEK DRAINAGE PROJECT AREA

Recurrence Interval (years)	Peak Discharge (cfs) by Drainage-Area Ratio	Peak Discharge (cfs) by Regional Flood-Frequency Equations
2	135	116
5	244	324
10	339	557
25	490	958
50	626	1389
100	783	1942

The known waste sources are all located upstream of Birdseye Road. The peak discharges for this upper portion of the Silver Creek basin were estimated using the regional flood-frequency equations. Peak discharges for the Silver Creek drainage upstream of Birdseye Road were estimated by regional flood-frequency equations (drainage area of 17.07 square miles and 26.3 percent of the basin above 6,000 feet in elevation) and are presented in Table 2-3.

TABLE 2-3 ESTIMATES OF PEAK DISCHARGE FOR THE SILVER CREEK DRAINAGE ABOVE BIRDSEYE ROAD

Recurrence Interval (years)	Peak Discharge (cfs) by Regional Flood-Frequency Equations
2	58
5	143
10	236
25	394
50	546
100	734

2.4 CURRENT SITE SETTING

2.4.1 Location and Topography

The Silver Creek drainage basin is located in Townships 11 and 12 North, Ranges 4, 5 and 6 West, in Lewis and Clark County on public and private land. The latitude of the basin is between North 46° 40' and 46° 50' and the longitude is between West 112° 00' and West 112° 21'. Silver Creek is formed by the confluence of streams flowing from Rawhide and Ottawa Gulches near the town of Marysville. From Marysville, Silver Creek flows eastward approximately 16 air miles, crossing the northern portion of the Helena Valley before it enters Lake Helena. Due to irrigation diversions and other withdrawals, Silver Creek is intermittent in its lower reaches and does not reach the lake. Lake Helena is connected to Hauser Lake on the Missouri River.

The highest point in the Silver Creek drainage basin is Mount Belmont at an elevation of 7,331 feet above sea level. The topography of the basin is mountainous and is mostly forested. The terrain surrounding the mines in the headwaters of the drainage basin is generally rugged, consisting of relatively steep slopes (15 to 20 degrees). The land is used for wildlife habitat, livestock grazing, and recreation. The western boundary of the drainage basin is formed by the Continental Divide.

2.4.2 Vegetation/Wildlife

The area in the upper portions of the Silver Creek drainage above the town of Marysville is mostly continuously timbered with Lodgepole pine, Douglas fir, Engelmann spruce, and some Ponderosa pine. The area is important habitat for a variety of big game animals (mule deer, elk, moose, black bear), fur bearers (beaver and bobcat), waterfowl and birds. The area in the lower portions of the drainage is characterized by juniper, sagebrush, and native grasses.

Recreation in the drainage includes hunting and fishing. Silver Creek was reported as a good quality fishery with numerous trout being counted in the upper portion of the creek during a fish survey (Montana Department of Fish and Game, 1977). The lower section of the creek had been reported as a good quality fishery, however no trout were found in the lower section during the fish survey possibly due to a fish kill.

The MDFWP fisheries information contained in the Montana Rivers Information System (MRIS) database (MRIS, 2002) indicates that Silver Creek is 21.6 miles long and has a Fisheries Resource Values (FRV) of 4 for both habitat class and sport class, with a final value of moderate. According to the MRIS database, Brook Trout are year-round residents and are considered present in abundance. Westslope Cutthroat Trout are year-round residents and are considered common in abundance. Brown Trout, Kokanee and Rainbow Trout are residents and use this stream reach for spawning, but are uncommon in abundance. Silver Creek is posted by MDFWP as catch and release only because of elevated mercury concentrations in fish tissue; however, this is not reported in the MRIS database.

2.4.3 Historic or Archaeologically Significant Features

(To be completed upon receipt of the Cultural Resources Inventory from DEQ)

2.4.4 Land Use and Population

The small community of Marysville is located on Silver Creek near its headwaters. An estimated 50 residents live year-round at Marysville, and approximately 10 additional cabins are located in the vicinity of the townsite for recreational/seasonal use. Recreational land use near Marysville includes hunting, fishing, camping, hiking, 4-wheeling, mountain biking, snowmobiling, and skiing. The Great Divide Ski Area is located at the base of Mt. Belmont and experiences approximately 30,000 to 40,000 skier days per year (Maxim, 1995).

2.5 PREVIOUS WORK

Previous sampling has been conducted by several parties in the Silver Creek area. Most of these studies have focused on the Goldsil millsite and tailings area. The following is a summary of the known sampling that has been completed:

- Maxim Technologies, Inc. completed a hydrologic baseline investigation of the Silver Creek drainage basin in 1996 for the DEQ-AMRB (DEQ-AMRB/Maxim, 1996). The study included surface water and point source discharge sampling, groundwater and stream sediment sampling.

- MDFWP and Montana Department of Health and Environmental Sciences (MDHES) completed a lake and selected stream water quality assessment and contaminant monitoring of fish and sediments from Montana waters in 1994 (MDFWP/MDHES, 1994). The highest concentrations of mercury observed in fish were from Silver Creek. No sediment samples were collected from Silver Creek.

- Pioneer Technical Services, Inc. (Pioneer) completed Hazardous Material Site Inventories for the Montana Department of State Lands, Abandoned Mine Reclamation Bureau (MDSL/AMRB) at the Bald Mountain Mine (MDSL/AMRB, 1993a), Belmont Mine (MDSL/AMRB, 1993b), Goldsil Millsite (MDSL/AMRB, 1993c) and Drumlummon Mine, Mill and Tailings (MDSL/AMRB, 1994). These inventories included surface water, stream sediment, waste, and background soil sampling, as well as assessments of other physical hazards.

- Roy F. Weston, Inc. collected samples from surface water, stream sediments, surface impoundments, pond sumps/seeps, soil and wastes in the Goldsil area for the MDHES (1988).

- An operating permit and reclamation plan was prepared for Goldsil Mining and Milling, Inc. by Hydrometrics, Inc. (Goldsil Mining and Milling, Inc., 1984a and 1984b). The permit application was for the mining of two small open pits and selected waste rock and tailings deposits near the Drumlummon Mine. Data presented in the application included an inventory of wells and springs in the Marysville area, and the collection of surface water and groundwater samples.

- The MDFWP collected samples of fish tissue and found mercury concentrations exceeding the recommended concentration established by the Food and Drug Administration (MDFWP, 1984). Silver Creek was subsequently restricted to catch and release only.

- Hydrometrics, Inc. (1983) collected water samples on behalf of Goldsil Mining and Milling, Inc. in response to a consent decree regarding alleged mercury contamination of Silver Creek and an alleged violation of water quality standards caused by seepage from the Goldsil Mining and Milling tailings pond.

- A study by the Montana Department of Fish and Game (1977) documented the seepage of water containing metals and cyanide from tailings ponds at the White (now Goldsil) mill. The report documents a decrease in macro-invertebrates and fish from above the tailings ponds to below the ponds. A fish kill reported on February 3, 1976 was suspected to have been caused by a release from the tailings ponds.

2.5.1 Stream Sediment

Stream sediment samples were collected during previous investigations from 23 different locations in the Silver Creek drainage basin. The results of these samples are presented in Table 2-4. Summary statistics from these sediment samples are presented in Table 2-5. Of particular interest are arsenic, cadmium, copper, lead, mercury and zinc, which are analyses in the Phase I Reconnaissance Site Characterization. These values are compared with the current study in Section 6.1.

2.5.2 Waste Sources

Tailings samples were collected during previous investigations from 15 different locations in the Silver Creek drainage basin. These locations included samples from the Bald Mountain, Belmont, Drumlummon and Goldsil Mine and Millsite areas. The results of these samples are presented in Table 2-4. Summary statistics from these tailings samples are presented in Table 2-6. Mill tailings in the Silver Creek Drainage Project area are addressed in the Phase II Detailed Site Characterization report (DEQ-MWCB/Olympus, 2003).

Waste rock samples were collected during previous investigations from 4 different locations in the Silver Creek drainage basin. These locations included samples from the Bald Mountain, Belmont and Drumlummon mine areas. The results of these samples are presented in Table 2-4. Summary statistics for waste rock samples are presented in Table 2-7. Waste rock in the Silver Creek Drainage Project area is addressed in the Phase II Detailed Site Characterization (DEQ-MWCB/Olympus, 2003).

Acid/base accounting data for tailings and waste rock samples from hazardous materials inventories for the Bald Mountain, Belmont, Drumlummon and Goldsil mines/millsites are summarized in Table 2-8.

2.5.3 Fish Tissue

Several investigations of the fishery and water quality in Silver Creek have been performed by State of Montana wildlife and health agencies. These include an evaluation of the causes of a fish kill in Silver Creek which occurred in September, 1976 (Montana Department of Fish and Game, 1977), a statewide water pollution study (MDFWP, 1984) and contaminant monitoring of fish and sediments (MDFWP, 1994). Concentrations of mercury as high as 4.3 mg/Kg in fish tissue have been measured. The U.S. Food and Drug Administration action level is 1.0 mg/Kg of mercury for fish. The fishery was made a catch and release only in 1983 by the Fish and Game Commission to protect human health. Fish tissue sample results are summarized in Table 2-9.

2.5.4 Surface Water

A total of 173 surface samples were collected during previous investigations from 74 reported location descriptions in the Silver Creek drainage basin. The sample results are presented in Table 2-10.

Table 2-4. Summary of Previous Silver Creek Drainage Stream Sediment and Mine/Mill Waste Sampling Results

Sample Station	Sample Date	Sample Location	Medium	Ag (mg/Kg)	Al (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Be (mg/Kg)	Cd (mg/Kg)	Co (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Bulk Sediment Hg (mg/Kg)	Fine Sediment Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Pb (mg/Kg)	Sb (mg/Kg)	Se (mg/Kg)	Zn (mg/Kg)	Total Cyanide (mg/Kg)	Source/Date
25-200-SW-01	10/11/95	Rawhide Gulch	Sediment	7	10500	15.0	110		3.0		15	37	16400	0.5	1.7	460	15	20		5	48		Maxim, 1996
25-200-SW-01	08/01/96	Rawhide Gulch	Sediment	6	23000	33.0	190		6.0		14	30	26700			1190	18	70		4	123		Maxim, 1996
25-200-SW-02	10/11/95	Marysville	Sediment	7	9340	13.0	110		4.4		11	22	19300	2.2	7.7	494	15	59		5	74		Maxim, 1996
25-200-SW-02	08/01/96	Marysville	Sediment	10	27900	35.0	240		5.9		15	50	27200			920	15	230		4	165		Maxim, 1996
25-200-SW-02	08/01/96	Marysville	Sediment	10	26600	31.0	240		6.2		15	47	26400			860	16	220		4	163		Maxim, 1996
25-200-SW-03	10/11/95	Jennies Fork at mouth	Sediment	18	7540	22.0	70		3.7		7	74	18300			1930	15	96		5	173		Maxim, 1996
25-200-SW-03	08/01/96	Jennies Fork at mouth	Sediment	30	18500	28.0	120		6.6		13	90	27400			1510	15	190		4	296		Maxim, 1996
25-200-SW-04	10/11/95	Below Drumlummon	Sediment	18	9400	17.0	110		4.0		11	73	17900	3.9	13	1910	15	114		5	202		Maxim, 1996
25-200-SW-04	08/01/96	Below Drumlummon	Sediment	19	21800	29.0	170		6.0		15	79	23700			1390	15	150		4	207		Maxim, 1996
25-200-SW-05	10/11/95	Sawmill Gulch at mouth	Sediment	7	17800	20.0	150		3.0		11	15	16700			316	15	20		5	48		Maxim, 1996
25-200-SW-05	08/01/96	Sawmill Gulch at mouth	Sediment	15	7090	11.0	70		2.6		11	26	9250			731	11	37		5	82		Maxim, 1996
25-200-SW-06	10/11/95	Breached Tailings Dam	Sediment	19	26600	18.0	150		5.4		18	61	21900	0.7	9.9	860	13	190		4	166		Maxim, 1996
25-200-SW-06	08/01/96	Breached Tailings Dam	Sediment	15	8240	33.0	70		3.7		7	44	16000			453	11	37		5	145		Maxim, 1996
25-200-SW-07	10/11/95	Goldsil Millsite	Sediment	11	8210	41.0	70		4.4		7	37	17000	4.6	20	438	11	37		5	96		Maxim, 1996
25-200-SW-07	10/11/95	Goldsil Millsite	Sediment	26	18000	42.0	150		6.8		15	103	25600			1320	15	160		4	216		Maxim, 1996
25-200-SW-07	08/01/96	Goldsil Millsite	Sediment	7	15600	16.0	220		3.3		11	33	12200			99	18	20		5	48		Maxim, 1996
25-200-SW-08	10/11/95	Sitzer Gulch at Birdseye Rd.	Sediment	15	9330	85.0	110		4.4		7	40	18500			849	15	20		5	113		Maxim, 1996
25-200-SW-09	10/11/95	Birdseye Rd.	Sediment	15	18600	60.0	290		6.9		14	90	29800	5	20	3510	18	150		4	139		Maxim, 1996
25-200-SW-09	08/01/96	Birdseye Rd.	Sediment	7	11800	20.0	330		4.4		15	15	17300			775	18	20		5	77		Maxim, 1996
25-200-SW-11	10/11/95	Silver Creek Estates Rd.	Sediment	18	7320	8.7	90		3.3		7	47	11200	8.8	2.4	468	11	25		5	102		Maxim, 1996
25-200-SW-11	08/01/96	Silver Creek Estates Rd.	Sediment	16	16000	11.0	200		3.3		12	66	16200			1400	17	80		4	160		Maxim, 1996
SW-10	10/11/95	Threemile Creek at Birdseye Rd.	Sediment											0.5									Maxim, 1996
25-167-TP-1	08/19/93	Belmont Mine	Tailings			28	30.2		1.0	1.61	2.87	56.8	6510	1.93		1190	2.38	48.4	10		230	NR	MDSL/AMRB, 1993a
25-167-TP-2	08/19/93	Belmont Mine	Tailings			32.2	36.2		0.7	1.85	2.61	38.1	6840	0.464		1520	3.54	38.1	5.74		208	<0.277	MDSL/AMRB, 1993a
25-167-WR-1	08/19/93	Belmont Mine	Waste Rock			19	26.5		0.4	3.07	4.46	35.8	10700	0.723		630	5.27	14.6	4.97		65.6	NR	MDSL/AMRB, 1993a
25-061-TP-1	08/19/93	Bald Mountain Mine	Tailings			14.3	50.4		0.9	3.62	5.94	79.1	9450	0.523		2200	4.55	142	6.37		256	NR	MDSL/AMRB, 1993b
25-061-TP-2	08/19/93	Bald Mountain Mine	Tailings			16.5	117		1.0	3.68	3.73	56.4	9870	0.964		1810	4.72	84.5	9.83		158	NR	MDSL/AMRB, 1993b
25-061-WR-1	08/19/93	Bald Mountain Mine	Waste Rock			48.8	64.7		0.7	6.81	5.51	36.6	14200	0.324		994	7.37	41.7	4.7		125	NR	MDSL/AMRB, 1993b
25-024-SE-1	08/23/94	Drumlummon Mine	Sediment	1.9		30.5	148		0.8	6.1	13.9	38.8	16100	0.18		1050	7.7	203	6.2		196	NR	MDSL/AMRB, 1994
25-024-SE-2	08/23/94	Drumlummon Mine	Sediment	4.5		19.8	150		0.7	6.0	8.7	30.6	13100	6.20		490	6.4	62.0	7.4		73.7	NR	MDSL/AMRB, 1994
25-024-SE-3	08/23/94	Drumlummon Mine	Sediment	18.8		13.5	71.8		1.5	3.9	9.0	60.7	9120	3.78		742	4.9	77.7	5.4		123	NR	MDSL/AMRB, 1994
25-024-TP-1	08/23/94	Drumlummon Mine	Tailings	27.4		33.7	99.2		0.7	4.3	12.5	149	11100	1.94		744	8.0	112	16.1		257	0.401	MDSL/AMRB, 1994
25-024-TP-2	08/23/94	Drumlummon Mine	Tailings	27.4		35.1	61.3		0.7	3.0	10.2	116	9230	1.85		626	5.9	117	12.9		205	0.219	MDSL/AMRB, 1994
25-024-WR-1	08/23/94	Drumlummon Mine	Waste Rock	0.4		21.7	46.2		0.4	5.6	16.9	30.1	23300	0.41		491	9.8	12.1	4.3		59.6	NR	MDSL/AMRB, 1994
25-024-WR-2	08/23/94	Drumlummon Mine	Waste Rock	5		46.2	57.0		2.8	4.2	9.3	55.3	13200	1.43		727	6.1	119	5.7		311	NR	MDSL/AMRB, 1994
25-365-SE-1	09/02/93	Goldsil Millsite	Sediment			66.6	83.3		1.0	4.26	5.27	31.8	11400	0.69		787	6.22	16.2	7		62.4	NR	MDSL/AMRB, 1993c
25-365-SE-2	09/02/93	Goldsil Millsite	Sediment			34.2	94		1.0	1.39	3.85	23.2	6400	3.11		480	3.14	12.2	7.06		64.1	NR	MDSL/AMRB, 1993c
25-365-TP-1	09/02/93	Goldsil Millsite	Tailings			41.2	51.7		2.0	2.35	6.07	197	8470	81.4		884	3.4	237	10.8		470	2.57	MDSL/AMRB, 1993c
25-365-TP-2	09/02/93	Goldsil Millsite	Tailings			37.1	52.5		2.0	1.97	4.92	187	7620	46.4		843	3.43	207	11.1		400	2.4	MDSL/AMRB, 1993c
25-365-TP-3	09/02/93	Goldsil Millsite	Tailings			13	58.6		1.0	3.48	6.54	53.1	8480	5.42		852	3.82	68.5	7.08		137	0.379	MDSL/AMRB, 1993c
25-365-TP-4	09/02/93	Goldsil Millsite	Tailings			34.9	74.8		2.0	4.9	18.6	198	11700	21.4		827	13	245	31.2		477	3.13	MDSL/AMRB, 1993c
25-365-TP-5	09/02/93	Goldsil Millsite	Tailings			84.5	117		3.5	5.96	15.3	379	18600	223		1430	14	537	66.9		1010	1.97	MDSL/AMRB, 1993c
25-365-TP-6	09/02/93	Goldsil Millsite	Tailings			36.6	59.9		3.4	4.35	7.86	160	9210	86		857	8.39	205	30.3		412	2.82	MDSL/AMRB, 1993c
SW-1-sed	Sep-88	3 mi. west of downstream entrance	Sediment											3.40									MDHES, 1988
SW-2-sed	Sep-88	0.9 mi west of downstream entance	Sediment											3.50									MDHES, 1988
SW-3-sed	Sep-88	At upstream entrance	Sediment	7.0	8160	69	59	1.5	1.0		7.0	84	12900	14		527		30			162		MDHES, 1988
SW-4-sed	Sep-88	Corner of upper lagoon	Sediment											28									MDHES, 1988
SW-5-sed	Sep-88	At downstream entrance (SW--07)	Sediment	15.1	5490	76	41		2.3		8.5	33	12900	4.0		681		10.7			87	28	MDHES, 1988
SW-6-sed	Sep-88	Just downstream from lower lagoon	Sediment											9.2									MDHES, 1988
SW-7-sed	Sep-88	Just downstream from Buck Lake	Sediment											33									MDHES, 1988
UL-1-sed	Sep-88	Lagoon, upstream from mill	Tailings	39	2730	65	31	0.9	3.3		7.9	172	8020	24		666		35			292		MDHES, 1988
ML-1-sed	Sep-88	Lagoon, just north of mill	Tailings	5.7	8780	157	70	2.9	4.8		14.8	100	17800	78		739		157			565		MDHES, 1988
LL-1-sed	Sep-88	Lagoon, just upstream from Buck Lake	Tailings	2.3	3790	61	50	3.2	2.8		13.9	168	12100	34		969		96			363	28	MDHES, 1988
SS-1	Sep-88	Soil composite, storage shed	Soil											12.0									MDHES, 1988
SS-2	Sep-88	Soil composite, process vats	Soil											17.0								8.7	MDHES, 1988

TABLE 2-5 SUMMARY STATISTICS FOR PREVIOUS SEDIMENT SAMPLING

Analyte	Mean (mg/Kg)	Median (mg/Kg)	Maximum (mg/Kg)	No. Samples
Ag	13.20	15	30	26
Al	14470.4	11800	27900	23
As	32.08	28.5	85	28
Ba	139.5	115	330	28
Be	1.5	1.5	1.5	1
Cd	3.77	3.7	6.9	28
Co	4.33	4.26	6.1	5
Cr	10.97	11	18	28
Cu	49.33	42	103	28
Fe	17745.4	16850	29800	28
Bulk Sediment Hg	6.76	3.84	33	20
Fine Sediment Hg	10.67	9.9	20	7
Mn	951.43	781	3510	28
Ni	13.09	15	18	26
Pb	84.17	60.5	230	28
Sb	6.61	7	7.4	5
Se	4.57	5	5	21
Zn	128.97	123	296	28

TABLE 2-6 SUMMARY STATISTICS FOR PREVIOUS TAILINGS SAMPLING

Analyte	Mean (mg/Kg)	Median (mg/Kg)	Maximum (mg/Kg)	No. Samples
Ag	20.36	27.4	39	5
Al	5100	3790	8780	3
As	46.01	35.1	157	15
Ba	63.99	58.6	117	15
Be	2.33	2.9	3.2	3
Cd	1.99	2	4.8	15
Co	3.42	3.55	5.96	12
Cr	8.92	7.86	18.6	15
Cu	140.6	149	379	15
Fe	10333.3	9230	18600	15
Hg	40.49	21.4	223	15
Mn	1077.1	857	2200	15
Ni	6.26	4.64	14	12
Pb	155.3	117	537	15
Sb	18.19	10.95	66.9	12
Zn	362.67	292	1010	15
Total Cyanide	4.65	2.4	28	9

TABLE 2-7 SUMMARY STATISTICS FOR PREVIOUS WASTE ROCK SAMPLING

Analyte	Mean (mg/Kg)	Median (mg/Kg)	Maximum (mg/Kg)	No. Samples
Ag	2.7	2.7	5	2
As	33.93	33.95	48.8	4
Ba	48.6	51.6	64.7	4
Cd	1.08	0.55	2.8	4
Co	4.92	4.9	6.81	4
Cr	9.04	7.41	16.9	4
Cu	39.45	36.2	55.3	4
Fe	15350	13700	23300	4
Hg	0.72	0.57	1.43	4
Mn	710.5	678.5	994	4
Ni	7.14	6.74	9.8	4
Pb	46.85	28.15	119	4
Sb	4.92	4.84	5.7	4
Zn	140.3	95.3	311	4

The most comprehensive of the previous surface water sampling was completed by Maxim (DEQ-AMRB/Maxim, 1996). This is also the most current of the previous studies, and most representative of the current, post-active mining and milling conditions. Maxim collected surface water samples from 11 sample stations from October 1995 through August 1996. Water quality analytical data from surface water samples indicated that concentrations of several metals, arsenic, cyanide and total dissolved solids occasionally exceeded either Federal secondary water quality standards, Montana human health standards or Federal aquatic life standards. Aluminum concentrations (exceeding aquatic standards) along with iron and manganese (exceeding Montana human health standards) were the most common metals to exceed standards. Arsenic, cadmium, copper, lead, mercury, zinc and cyanide exceeded Montana and aquatic standards only occasionally. Total dissolved solids exceeded Federal drinking water secondary standards in three samples.

Surface water data collected by the MDHES, MDFWP and the Bureau of Land Management were reported in an operating permit application prepared by Goldsil Mining and Milling, Inc. (Goldsil Mining and Milling, Inc., 1984a and 1984b). Surface water was reported as excellent with the exception of detections of mercury occasionally reported. The water was classified as non-saline, very hard, calcium-bicarbonate type with low concentrations of turbidity and metals. Except for mercury, the water would meet all federal water quality standards (DEQ-AMRB/Maxim, 1996).

2.5.5 Ground Water and Adit Discharges

Groundwater and adit discharge samples were collected during previous investigations in the Silver Creek drainage basin. A total of 38 samples have been collected from 27 different locations. Of these 38 samples, 24 were groundwater samples and 14 were adit discharge samples. The sample results are presented in Table 2-11.

Table 2-8. Summary of Previous Silver Creek Drainage Acid/Base Accounting Results

Sample Station	Sample Date	Sample Location	Medium	Total Sulfur %	Total Sulfur Acid Base t/1000t	Neutral. Potent. t/1000t	Sulfur Acid Base Potent. t/1000t	Sulfate Sulfur %	Pyritic Sulfur %	Organic Sulfur %	Pyritic Sulfur Acid Base t/1000t	Sulfur Acid Base Potent. t/1000t	Reference
25-365-TP-1	09/02/93	Goldsil Millsite	Tailings	0.03	0.94	84.1	83.1	0.01	<0.01	0.02	0	84.1	MDSL/AMRB, 1995c
25-365-TP-2	09/02/93	Goldsil Millsite	Tailings	<0.01	0	68.5	68.5	<0.01	0.02	0.02	0.62	67.8	MDSL/AMRB, 1995c
25-365-TP-3	09/02/93	Goldsil Millsite	Tailings	<0.01	0	49.9	49.9	<0.01	<0.01	<0.01	0	49.9	MDSL/AMRB, 1995c
25-365-TP-4	09/02/93	Goldsil Millsite	Tailings	<0.01	0	78.5	78.5	<0.01	<0.01	0.02	0	78.5	MDSL/AMRB, 1995c
25-365-TP-5	09/02/93	Goldsil Millsite	Tailings	0.05	1.56	124	122	0.01	0.01	0.03	0.31	123	MDSL/AMRB, 1995c
25-365-TP-6	09/02/93	Goldsil Millsite	Tailings	0.22	6.87	82.9	76.1	0.09	0.03	0.1	0.94	82	MDSL/AMRB, 1995c
25-024-TP1	6/23-24/93	Drumlummon	Tailings	0.01	0.31	72.6	72.3	<0.01	<0.01	0.01	0	72.6	MDSL/AMRB, 1995d
25-024-TP2	6/23-24/93	Drumlummon	Tailings	0.01	0.31	82.0	81.7	<0.01	<0.01	0.01	0	82.0	MDSL/AMRB, 1995d
25-024-WR1	6/23-24/93	Drumlummon	Waste Rock	0.04	1.25	153	152	<0.01	0.07	0.05	2.19	151	MDSL/AMRB, 1995d
25-024-WR2	6/23-24/93	Drumlummon	Waste Rock	0.15	4.69	91.3	86.6	0.07	0.03	0.05	0.94	90.4	MDSL/AMRB, 1995d
25-167-TP-1	08/19/93	Belmont	Tailings	<0.01	0	74.3	74.3	<0.01	<0.01	0.01	0	74.3	MDSL/AMRB, 1995b
25-167-TP-2	08/19/93	Belmont	Tailings	<0.01	0	74.4	74.4	<0.01	<0.01	<0.01	0	74.4	MDSL/AMRB, 1995b
25-167-WR-1	08/19/93	Belmont	Waste Rock	<0.01	0	96.8	96.8	<0.01	0.01	0.01	0.31	96.5	MDSL/AMRB, 1995b
25-061-TP-1	08/19/93	Bald Mountain	Tailings	0.07	2.19	38.7	36.6	0.03	0.01	0.03	0.31	38.4	MDSL/AMRB, 1995a
25-061-TP-2	08/19/93	Bald Mountain	Tailings	0.01	0.31	60.1	59.8	<0.01	0.01	0.01	0.31	59.8	MDSL/AMRB, 1995a
25-061-TP-2DUP	08/19/93	Bald Mountain	Tailings	<0.01	0	60.3	60.3	<0.01	0.01	0.01	0.31	60	MDSL/AMRB, 1995a
25-061-WR-1	08/19/93	Bald Mountain	Waste Rock	0.02	0.62	57.9	57.2	<0.01	<0.01	0.03	0	57.9	MDSL/AMRB, 1995a

Table 2-9. Summary of Silver Creek Drainage Fish Tissue Mercury Results

Fish Species	Sampling Date	Site Description	Size range (inches)	Number of Samples	Hg (ug/g)	Hg Concentration (ug/g wet weight) Mean	Range	Reference
Cutthroat trout	1992	not available	12.7	1	1.6			MWFP and MDHES, 1994
Cutthroat trout	1992	not available	17.1	1	3.1			MWFP and MDHES, 1994
Cutthroat trout	1992	not available	18.7	1	3.0			MWFP and MDHES, 1994
Cutthroat trout	June, 1983	above Buck Lake	5.8-17.0	6		1.68	0.38-4.30	MWFP, 1984
Cutthroat trout	June, 1983	near Chairman Gulch	5.4-9.9	5		0.38	0.29-0.52	MWFP, 1984

Table 2-10. Summary of Silver Creek Drainage Surface Water Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	Discharge (cfs)	Field pH (s.u.)	Lab pH (s.u.)	Field Specific Conductivity (umhos/cm)	Lab Specific Conductivity (umhos/cm)	Lab Turbidity (JTU)	Water Temp (C)	Oxidation Reduction Potential (mv)	Ag (ug/L) Total/Dissolved	Al (ug/L) Total/Dissolved	As (ug/L) Total/Dissolved	Ba (ug/L) Total/Dissolved	Cd (ug/L) Total/Dissolved	Co (ug/L)	Cr (ug/L) Total/Dissolved	Cu (ug/L) Total/Dissolved	Fe (ug/L) Total/Dissolved	Hg (ug/L) Total/Dissolved	Mn (ug/L) Total/Dissolved	Ni (ug/L) Total/Dissolved	Pb (ug/L) Total/Dissolved
		WQB-7-Human Health Standard	Surface Water									100		18	2000	5		100	1300	300	0.05	50	100	15
		WQB-7 Acute Aquatic Life Standard	Surface Water									13.4*	750	340		4.3*		NA**	26.9*		1.7		843.3*	197.3*
		WQB-7 Chronic Aquatic Life Standard	Surface Water										87	150		0.45*		NA**	16.9*	1000	0.91		93.8*	7.7*
Culvert Intake	03/27/02	Silver Crk Ranchette Rd.	Surface Water									ND		11	ND	ND		ND	20	1090	ND	120	ND	ND
Transfer Station Rd	03/27/02	Silver Crk - at Transfer Station Rd.	Surface Water									ND		5	ND	ND		ND	ND	ND	ND	ND	ND	ND
25-200-SW-01	10/11/95	Rawhide Gulch at Ski road	Surface Water	0.20	7.4	8.0	188	173		8.0	-240	50/50	200/200	1/1	200/200	.2/.2		10/10	1/1	80/50	.2/.2	15/15	2/2	1/1
25-200-SW-01	02/08/96	Rawhide Gulch at Ski road	Surface Water	0.02	6.7	7.3	186	160		6.0		50/50	300/200	1/1	200/200	.2/.2		10/10	5/5	280/50	.2/.2	15/15	2/2	1/1
25-200-SW-01	05/01/96	Rawhide Gulch at Ski road	Surface Water	0.28	6.8	8.2	224	170		4.0		50/50	200/200	1/1	200/200	.2/.2		10/10	5/5	50/50	.2/.2	15/15	2/2	1/1
25-200-SW-01	08/28/96	Rawhide Gulch at Ski road	Surface Water	0.13	7.0	7.8	162	180		10.0		50/50	500/200	2/2	200/200	2.9/1.4		10/10	2/2	510/80	.2/.2	60/23	2/2	40/30
25-200-SW-02	10/11/95	Silver Creek at Marysville	Surface Water	1.32	7.4	7.9	192	187		9.0		50/50	200/200	2/2	200/200	.2/.2		10/10	5/1	50/50	.2/.2	15/15	2/2	2/1
25-200-SW-02	02/08/96	Silver Creek at Marysville	Surface Water	0.46	7.6	7.4	228	234		7.0		50/50	200/200	2/2	200/200	.2/.2		10/10	5/5	290/50	.2/.2	25/15	2/2	3/1
25-200-SW-02	05/01/96	Silver Creek at Marysville	Surface Water	1.70	7.9	8.2	245	242		8.0		50/50	400/200	2/2	200/200	.2/.2		10/10	5/5	290/50	.2/.2	20/15	2/2	4/1
25-200-SW-02	08/28/96	Silver Creek at Marysville	Surface Water	1.22	6.2	7.9	233	267		12.0		50/50	900/200	2/2	200/200	.2/.2		10/10	4/2	80/18	.2/.2	56/49	2/2	9/4
25-200-SW-02A	08/28/96	Silver Creek immediately below Drumlummon waste rock pile	Surface Water		7.0	8.0	231	284		12.0		50/50	3200/200	5/1	200/200	5/1.6		10/10	6/3	2690/190	.2/.2	122/63	2/2	7/5
25-200-SW-03	10/11/95	Jennies Fork; at County Road	Surface Water	0.40	7.5	8.4	325	276		9.5		50/50	200/200	2/2	200/200	.2/.2		10/10	3/1	200/50	.2/.2	38/15	2/2	1/1
25-200-SW-03	02/08/96	Jennies Fork; at County Road	Surface Water	0.67	8.0	7.9	300	297		4.3		50/50	300/200	3/3	200/200	.2/.2		10/10	5/5	370/50	.2/.2	43/15	2/2	2/1
25-200-SW-03	05/01/96	Jennies Fork; at County Road	Surface Water	0.74	6.6	8.4	300	271		5.0		50/50	400/200	3/2	200/200	.2/.2		10/10	5/5	330/50	.2/.2	53/15	2/2	4/1
25-200-SW-04	10/11/95	Silver Creek at Skid Road (continuous recorder station)	Surface Water	1.53	7.2	8.2	232	276		10.0		50/50	200/200	2/2	200/200	.2/.2		10/10	3/1	80/50	.2/.2	18/15	2/2	1/1
25-200-SW-04	02/08/96	Silver Creek at Skid Road (continuous recorder station)	Surface Water	1.57	7.6	7.2	245	230		6.0		50/50	2700/200	7/2	200/200	.2/.2		10/10	18/5	2630/50	.2/.2	2940/15	2/2	18/1
25-200-SW-04	05/01/96	Silver Creek at Skid Road (continuous recorder station)	Surface Water	4.29	6.5	8.3	551	236		5.0		50/50	800/200	3/3	200/200	.2/.2		10/10	5/5	750/50	.2/.2	61/15	2/2	6/1
25-200-SW-04	08/28/96	Silver Creek at Skid Road (continuous recorder station)	Surface Water	1.75	6.8	8.2	250	293		12.0		50/50	500/200	2/2	200/200	6/6		10/10	3/2	590/100	.2/.2	520/31	2/2	4/2
25-200-SW-05	10/11/95	Sawmill Gulch	Surface Water	0.38	8.0	8.4	310	355		12.0		50/50	200/200	4/3	200/200	.2/.2		10/10	6/1	150/50	.2/.2	22/15	2/2	2/1
25-200-SW-05	02/08/96	Sawmill Gulch	Surface Water	0.75	7.9	7.4	354	298		6.0		50/50	700/200	5/2	200/200	.2/.2		10/10	5/5	510/50	.2/.2	28/15	2/2	1/1
25-200-SW-05	05/01/96	Sawmill Gulch	Surface Water	3.32	8.1	8.5	374	375		8.0		50/50	700/200	3/3	200/200	.2/.2		10/10	5/5	340/50	.2/.2	18/15	2/2	2/1
25-200-SW-06	10/11/95	Silver Creek immediately above reclaimed tailings channel	Surface Water	1.60	3.5	8.5	335	296		13.0		50/50	900/200	4/2	200/200	.2/.2		10/10	6/1	830/50	.4/.2	55/33	2/2	5/1
25-200-SW-06	02/08/96	Silver Creek immediately above reclaimed tailings channel	Surface Water	2.15	8.1	7.7	317	297		4.0		50/50	500/200	2/2	200/200	.2/.2		10/10	5/5	460/50	.2/.2	530/15	2/2	3/1
25-200-SW-06	05/01/96	Silver Creek immediately above reclaimed tailings channel	Surface Water	8.65	7.2	8.5	382	328		6.0		50/50	400/200	3/3	200/200	.2/.2		10/10	5/5	280/50	.2/.2	31/15	2/2	3/1
25-200-SW-06	08/28/96	Silver Creek immediately above reclaimed tailings channel	Surface Water	2.31	7.8	8.4	288	323		16.0		50/50	400/200	4/2	200/200	8/2		10/10	4/4	400/70	.2/.2	44/34	2/2	2/2
25-200-SW-07	10/11/95	Silver Creek at Goldsil, second culvert	Surface Water	1.23	7.6	8.3	328	395		11.0		50/50	200/200	8/8	200/200	.2/.2		10/10	3/1	160/50	.2/.2	31/29	2/2	1/1
25-200-SW-07	10/11/95	Duplicate 25-200-SW-07 (10/11/95)	Surface Water	1.23	7.6	8.1	328	395		11.0		50/50	200/200	8/8	200/200	.2/.2		10/10	1/1	140/50	.2/.2	32/29	2/2	1/1
25-200-SW-07	02/08/96	Silver Creek at Goldsil, second culvert	Surface Water	4.10	7.8	7.2	282	288		7.0		50/50	200/200	8/4	200/200	.2/.2		10/10	5/5	530/70	.2/.2	82/30	2/2	2/1
25-200-SW-07	05/01/96	Silver Creek at Goldsil, second culvert	Surface Water	9.48	8.1	8.5	357	350		8.0		50/50	200/200	5/4	200/200	.2/.2		10/10	5/5	80/50	.2/.2	21/17	2/2	1/1
25-200-SW-07	05/01/96	Duplicate 25-200-SW-07 (05/01/96)	Surface Water	9.48	8.1	8.5	357	347		8.0		50/50	200/200	8/3	200/200	.2/.2		10/10	5/5	90/50	.2/.2	22/16	2/2	1/1
25-200-SW-07	08/28/96	Silver Creek at Goldsil, second culvert	Surface Water	2.50	6.8	7.9	337	385		17.8		50/50	200/200	13/13	200/200	4/2		10/10	2/2	310/210	.2/.2	68/63	2/2	3/1
25-200-SW-08	10/11/95	Sitzer Gulch at Birdseye Road	Surface Water	0.13	6.5	8.2	810	792		14.0		50/50	200/200	8/3	200/200	.2/.2		10/10	1/1	100/50	.2/.2	73/73	2/2	1/1
25-200-SW-08	02/08/96	Sitzer Gulch at Birdseye Road	Surface Water	4.50	7.5	7.4	201	199		3.0		50/50	3500/200	4/3	200/200	.2/.2		10/10	14/5	3690/130	.2/.2	214/68	3/2	3/1
25-200-SW-08	05/01/96	Sitzer Gulch at Birdseye Road	Surface Water	0.30	8.0	8.2	703	726		9.0		50/50	200/200	10/4	200/200	.2/.2		10/10	5/5	120/50	.2/.2	53/46	2/2	1/1
25-200-SW-09	10/11/95	Silver Creek at railroad trestle below Sitzer (continous recorder sta.)	Surface Water	0.92	7.7	8.4	422	424		13.0		50/50	200/200	13/13	200/200	.2/.2		10/10	2/1	90/50	.2/.2	15/15	2/2	1/1
25-200-SW-09	02/08/96	Silver Creek at railroad trestle below Sitzer (continous recorder sta.)	Surface Water	65.00	7.8	7.4	202	198		4.0		50/50	1500/200	12/9	200/200	.2/.2		10/10	8/5	170/90	.2/.2	114/46	2/2	1/1
25-200-SW-09	05/01/96	Silver Creek at railroad trestle below Sitzer (continous recorder sta.)	Surface Water	9.35	8.1	8.5	393	380		12.0		50/50	200/200	9/5	200/200	.2/.2		10/10	5/5	200/50	.2/.2	36/15	2/2	1/1
25-200-SW-09	08/28/96	Silver Creek at railroad trestle below Sitzer (continous recorder sta.)	Surface Water	2.40	7.7	8.3	366	401		20.0		50/50	200/200	25/25	200/200	.2/.2		10/10	2/2	430/180	.2/.2	77/30	2/2	2/2
25-200-SW-10	10/11/95	Threemile Creek	Surface Water	0.13	7.1	8.3	432	385		13.0		50/50	200/200	24/20	200/200	.2/.2		10/10	6/1	80/50	.2/.2	15/15	2/2	1/1
25-200-SW-10	02/08/96	Threemile Creek	Surface Water	8.50	7.8	7.7	118	102		4.0		50/50	4200/200	14/14	200/200	.2/.2		10/10	8/5	3960/100	.2/.2	214/16	3/2	7/1
25-200-SW-10	05/01/96	Threemile Creek	Surface Water	1.00	8.1	8.4	432	366		7.0		50/50	300/200	14/7	200/200	.2/.2		10/10	5/5	290/50	.2/.2	39/16	2/2	2/1
25-200-SW-11	10/11/95	Silver Creek at Silver Creek Estates Road	Surface Water	1.31	8.0	8.3	825	776		13.0		50/50	200/200	12/8	200/200	.2/.2		10/10	5/3	190/50	.2/.2	82/72	2/2	1/1
25-200-SW-11	02/08/96	Silver Creek at Silver Creek Estates Road	Surface Water	45.00	7.4	7.2	160	178		4.0		50/50	2800/200	8/8	200/200	.3/.2		10/10	21/5	2930/160	.2/.2	3260/136	3/2	10/1
25-200-SW-11	02/08/96	Duplicate 25-200-SW-11 (02/08/96)	Surface Water	45.00	7.4	6.9	160	184		4.0		50/50	3900/200	8/8	200/200	.2/.2		10/10	27/5	3350/140	.2/.2	3580/13400	3/2	12/1
25-200-SW-11	05/01/96	Silver Creek at Silver Creek Estates Road	Surface Water	10.45	8.2	8.4	588	594		10.0		50/50	500/200	9/8	200/200	.2/.2		10/10	7/7	460/50	.2/.2	80/48	2/2	2/1
25-200-SW-11	08/28/96	Silver Creek at Silver Creek Estates Road	Surface Water	1.50	8.1	8.2	809	925		19.0		50/50	300/200	20/18	200/200	.5/.2		10/10	8/7	390/150	.2/.2	167/168	2/2	2/2
25-200-SW-11	08/28/96	Duplicate 25-200-SW-11 (08/28/96)	Surface Water			8.2		925				50/50	300/200	20/20	200/200	.2/.2		10/10	10/7	390/140	.2/.2	166/166	2/2	2/2
25-365-SW-1	09/02/93	Goldsil Millsite - at toe of berm w/flow gate in Silver Crk	Surface Water											5.29	82.7	4.59	5	6.24	2.33	123	0.12	21.8	10.9	1.13
25-365-SW-2	09/02/93	Goldsil Millsite - Silver Crk at culvert (downgradient) at rd.	Surface Water											4.35	73.6	4.59	5	6.24	2.33	90.8	0.12	15.3	10.9	1.69
25-365-SW-3	09/02/93	Goldsil Millsite - Silver Crk upgradient (200') from Argo mill bldg.	Surface Water											2.56	68.4	4.59	5	6.24	2.33	93.3	0.12	16.9	10.9	1.53
25-365-SW-5	09/02/93	Goldsil Millsite - pregnant pond below mill	Surface Water																					
25-024-AD1	6/23-24/93	Drumlummon - Adit discharge on WR4	Surface Water									0.14		34.9	128	2.6	8.7	4.7	4.6	2140	0.11	1640	8.0	2.1
25-024-SW1	6/23-24/93	Drumlummon - Ottawa Gulch (Silver Crk) upstream of mines and mills	Surface Water									0.12		2.2	94	2.6	8.7	4.9	4.6	44.1	0.11	8.0	9.8	2.9
25-024-SW2	6/23-24/93	Drumlummon - Silver Crk below mines, mills and TP1	Surface Water									0.12		2.1	81.9	2.6	8.7	4.7	4.6	91.4	0.11	21.8	8.0	2.3
25-024-SW3	6/23-24/93	Drumlummon - Silver Crk below tailings TP2, two miles below mills	Surface Water									0.12		3.6	74.4	2.6	8.7	5.9	7.3	262	0.11	41.3	8.0	6.8
SW-1	07/08/88	Goldsil Millsite - Silver Crk 3 mi. west of lower gate	Surface Water		8.3		150			11											0			
SW-2	07/08/88	Goldsil Millsite - Silver Crk 0.9 mi. west of lower gate	Surface Water		8.2		165			11											0			
SW-3	07/08/88	Goldsil Millsite - Silver Crk at upstream entrance to site	Surface Water		7.9		180			11		0	0	0	0	0		0	0	0	0	0	0	16.8
SW-4	07/08/88	Goldsil Millsite - Silver Crk N.E. corner of upper lagoon	Surface Water																		0			
SW-5	07/08/88	Goldsil Millsite - Silver Crk at downstream entrance to site	Surface Water		8.3		200			12		0	0	0	0	0	0	0	0	0	0	25	0	6.9
SW-6	07/08/88	Goldsil Millsite - Silver Crk just below lower lagoon	Surface Water		7.3		255			19											0			

Table 2-10. Summary of Silver Creek Drainage Surface Water Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	Discharge (cfs)	Field pH (s.u.)	Lab pH (s.u.)	Field Specific Conductivity (umhos/cm)	Lab Specific Conductivity (umhos/cm)	Lab Turbidity (JTU)	Water Temp (C)	Oxidation Reduction Potential (mv)	Ag (ug/L) Total/Dissolved	Al (ug/L) Total/Dissolved	As (ug/L) Total/Dissolved	Ba (ug/L) Total/Dissolved	Cd (ug/L) Total/Dissolved	Co (ug/L)	Cr (ug/L) Total/Dissolved	Cu (ug/L) Total/Dissolved	Fe (ug/L) Total/Dissolved	Hg (ug/L) Total/Dissolved	Mn (ug/L) Total/Dissolved	Ni (ug/L) Total/Dissolved	Pb (ug/L) Total/Dissolved
		WQB-7-Human Health Standard	Surface Water									100		18	2000	5		100	1300	300	0.05	50	100	15
		WQB-7 Acute Aquatic Life Standard	Surface Water									13.4*	750	340		4.3*		NA**	26.9*		1.7		843.3*	197.3*
		WQB-7 Chronic Aquatic Life Standard	Surface Water										87	150		0.45*		NA**	16.9*	1000	0.91		93.8*	7.7*
SW-7	07/08/88	Goldsil Millsite - Silver Crk just below Buck Lake	Surface Water		7.3		200			16											0			
LL-1	07/08/88	Goldsil Millsite - spring below the lower lagoon	Surface Water		7.7		310			15		0	0	0		7	0	0	0	358	1.1	90	0	0
ML-1	07/08/88	Goldsil Millsite - lagoon just north of mill	Surface Water									0	0	74.5	0	0	0	19	35	294	9.8	19	0	17.3
UL-1	07/08/88	Goldsil Millsite - lagoon upstream from mill	Surface Water									269	3330	21.5	0	10	0	16	1160	6070	89	504	40	8.1
H7	12/07/81	Silver Crk - above Maskelyne Tunnel; above mine office entrance road	Surface Water	0.66		7.4		245	2.3			<5/<5	1700/<100	<5/<5	<100/<100	<1/<1		<20/<20	10/10	100/30	<1/<1	30/20		10/10
H7	06/10/82	Silver Crk - above Maskelyne Tunnel; above mine office entrance road	Surface Water	5.35															<10		<0.2			<10
H7	10/25/82	Silver Crk - above Maskelyne Tunnel; above mine office entrance road	Surface Water	0.88				250	1.3										<10/<10		<1/<1			10/10
H7	12/14/83	Silver Crk - above Maskelyne Tunnel; above mine office entrance road	Surface Water	0.52					2 (Est.)															
H9	10/21/81	Ottawa Gulch just above Obie Adit	Surface Water	0.65		7.8	235	230	3.7	1.2		<5/<5	100/<100	<5/<5	<100/<100	2/<1		<20/<20	10/<10	150/<30	0.2/0.2	<20/<20		<10/<10
H11	12/14/83	Jennies Fork; at county road bridge	Surface Water	0.048						2 (Est.)														
H12	12/14/83	Silver Creek; below Jennies Fork	Surface Water	0.65					2 (Est.)															
H13	12/14/83	Silver Creek above Sawmill Gulch	Surface Water	0.79					2 (Est.)															
H14	12/14/83	Sawmill Gulch above Silver Creek	Surface Water	0.5 (Est.)					2 (Est.)															
FG1/H15	10/21/76	Silver Creek; below China Gulch	Surface Water					348				10							<10		<0.2			<50
FG1/H15	11/15/74	Silver Creek; below China Gulch	Surface Water																					
FG1/H15	11/29/76	Silver Creek; below China Gulch	Surface Water																					
FG1/H16	10/21/76	Silver Creek; below China Gulch	Surface Water					414				10							<10		<0.2			<50
H17	11/23/74	Silver Creek above China Gulch	Surface Water				384			4.3														
H18	11/23/76	Silver Creek above China Gulch	Surface Water				357			3.6														
H19	11/23/76	Silver Creek above China Gulch	Surface Water				297			3.4														
H20	11/23/76	China Gulch above Silver Creek	Surface Water				371			3.0														
H21	11/23/76	Silver Creek; below China Gulch	Surface Water				321			3.3														
H22	11/23/76	Silver Creek above tailings	Surface Water				299			2.0														
H23	11/23/76	Silver Creek above tailings	Surface Water				333			3														
H24	11/23/76	Silver Creek at Mill	Surface Water				365			4.7														
H25	11/23/76	Silver Creek below Mill	Surface Water				365			4.5														
H26	11/23/76	Silver Creek near Clear Pond	Surface Water				373			3.9														
H27	11/23/76	Silver Creek above gravel road	Surface Water				383			3														
H28	11/23/76	Silver Creek above Sitzer	Surface Water				393			2.1														
WQ1/H6	09/17/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water		8.3	8.12		362				<10/<10		5/5		<5/<5			<10/<10	80/30	<.2/<.2			<50/<50
WQ1/H6	10/23/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water			8.43		372				<10							<10	30	<.2			
WQ1/H6	10/28/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water			8.48		345				<10							70	70	<.2			
WQ1/H6	10/29/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water	0.86				330				<1							30		<1			
WQ1/H6	10/30/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water																					
WQ1/H6	12/10/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water			7.75						<10							<10		<.2			
WQ1/H6	06/30/81	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water	6.34				340	2.0												<.2			
WQ2/H5	10/09/80	Silver Crk - at entrance to Goldsil mill	Surface Water			8.05		414				<10							<10		<.2			
WQ2/H5	10/15/80	Silver Crk - at entrance to Goldsil mill	Surface Water			8.08		385				<10							<10		<.2			
WQ2/H5	10/23/80	Silver Crk - at entrance to Goldsil mill	Surface Water			8.23		449				<10							<10	<0.13	<.2			
WQ2/H5	10/28/80	Silver Crk - at entrance to Goldsil mill	Surface Water			8.22		405				<10							<10	70	<.2			
WQ2/H5	10/29/80	Silver Crk - at entrance to Goldsil mill	Surface Water	2.12				400				<1							30		<1			
WQ2/H5	06/30/81	Silver Crk - at entrance to Goldsil mill	Surface Water	9.40				350	1.2												0.4			
WQ2/H5	06/10/82	Silver Crk - at entrance to Goldsil mill	Surface Water																		<.2			
WQ2/H5	10/25/82	Silver Crk - at entrance to Goldsil mill	Surface Water	2.19				393	1.4												<1/<1			
WQ2/H5	11/16/83	Silver Crk - at entrance to Goldsil mill	Surface Water																					
WQ12/H4	10/09/80	Silver Crk - above Upper Pond	Surface Water			7.93		414				<10							<10		<.2			
WQ12/H4	10/15/80	Silver Crk - above Upper Pond	Surface Water			8.20		393				<10							<10		<.2			
WQ12/H4	10/29/80	Silver Crk - above Upper Pond	Surface Water	2.32				400				<10							20		<1			
WQ12/H4	06/30/81	Silver Crk - above Upper Pond	Surface Water	8.05				350	1.4												0.3			
WQ10	10/28/80	Silver Crk - between Upper & Lower Ponds	Surface Water			8.32		441				<10							10	120	<.2			
WQ3/H3	10/09/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water			8.33		426				10							20		9			
WQ3/H3	10/15/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water			8.32		408				<10							<10		4			
WQ3/H3	10/23/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water			8.42		484				10							<10	130	0.8			
WQ3/H3	10/28/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water			8.33		431				<10							<10	0.11	<.2			
WQ3/H3	12/10/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water		7.10							<10							<10		<.2			
WQ5	10/09/80	Silver Crk - below seep	Surface Water			8.27		438				20							40		10			
WQ5	10/15/80	Silver Crk - below seep	Surface Water			8.30		395				10							20		12			
WQ5	10/23/80	Silver Crk - below seep	Surface Water			8.34		512				10							10	180	12			
WQ5	10/28/80	Silver Crk - below seep	Surface Water			8.40		447				<10							10	110	3			

Table 2-10. Summary of Silver Creek Drainage Surface Water Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	Discharge (cfs)	Field pH (s.u.)	Lab pH (s.u.)	Field Specific Conductivity (umhos/cm)	Lab Specific Conductivity (umhos/cm)	Lab Turbidity (JTU)	Water Temp (C)	Oxidation Reduction Potential (mv)	Ag (ug/L) Total/Dissolved	Al (ug/L) Total/Dissolved	As (ug/L) Total/Dissolved	Ba (ug/L) Total/Dissolved	Cd (ug/L) Total/Dissolved	Co (ug/L)	Cr (ug/L) Total/Dissolved	Cu (ug/L) Total/Dissolved	Fe (ug/L) Total/Dissolved	Hg (ug/L) Total/Dissolved	Mn (ug/L) Total/Dissolved	Ni (ug/L) Total/Dissolved	Pb (ug/L) Total/Dissolved
		WQB-7-Human Health Standard	Surface Water									100		18	2000	5		100	1300	300	0.05	50	100	15
		WQB-7 Acute Aquatic Life Standard	Surface Water									13.4*	750	340		4.3*		NA**	26.9*		1.7		843.3*	197.3*
		WQB-7 Chronic Aquatic Life Standard	Surface Water										87	150		0.45*		NA**	16.9*	1000	0.91		93.8*	7.7*
WQ5	12/10/80	Silver Crk - below seep	Surface Water			8.16						<10							10		0.2			
WQ6/H2	11/15/76	Silver Crk - below seep	Surface Water																					
WQ6/H2	11/29/76	Silver Crk - below seep	Surface Water																					
WQ6/H2	09/17/80	Silver Crk - above Buck Lake	Surface Water		8.4	8.34		420				<20/<10		6/6		<5/<5			60/70	90/50	7/7			<50/<50
WQ6/H2	10/09/80	Silver Crk - above Buck Lake	Surface Water			8.34		429				10							30		9			
WQ6/H2	10/15/80	Silver Crk - above Buck Lake	Surface Water			8.29		423				<10							20		8			
WQ6/H2	10/23/80	Silver Crk - above Buck Lake	Surface Water			8.33		516				10							10	180	6			
WQ6/H2	10/28/80	Silver Crk - above Buck Lake	Surface Water			8.29		448				<10							10	110	2			
WQ6/H2	10/29/80	Silver Crk - above Buck Lake	Surface Water	2.78				410				2							30		9.1			
WQ6/H2	06/30/81	Silver Crk - above Buck Lake	Surface Water	8.14				355	2.4												0.3			
WQ6/H2	06/21/82	Silver Crk - above Buck Lake	Surface Water																					
WQ6/H2	10/25/82	Silver Crk - above Buck Lake	Surface Water	2.14				396	4.8												<1/<1			
WQ4/H1	09/17/80	Silver Crk - seep	Surface Water		7.9	7.76		762				120/420		2/2		5/5			5500/5500	130/100	850/840			50/50
WQ4/H1	10/23/80	Silver Crk - seep	Surface Water			7.56		791				800							1000	40	800			
WQ4/H1	10/28/80	Silver Crk - seep	Surface Water			7.56		759				90							710	110	800			
WQ4/H1	10/29/80	Silver Crk - seep	Surface Water	0.009				690				32							500		1030			
WQ4/H1	10/29/80	Silver Crk - seep	Surface Water	0.009																				
WQ4/H1	12/10/80	Silver Crk - seep	Surface Water			7.64						20							30		200			
WQ4/H1	06/30/81	Silver Crk - seep	Surface Water	0.003				640	0.55												38			
WQ4/H1	06/30/81	Silver Crk - seep	Surface Water	0.003				640	0.62												42			
WQ4/H1	06/21/82	Silver Crk - seep	Surface Water																					
WQ4/H1	10/25/82	Silver Crk - seep	Surface Water					605	1.3												8/8			
WQ4/H1	10/25/82	Silver Crk - seep	Surface Water	2.14				396	4.8												1/1			
WQ7	10/09/80	Silver Crk - below Buck Lake	Surface Water			8.05		400				10							30		1.6			
WQ7	10/23/80	Silver Crk - below Buck Lake	Surface Water			8.14		486				10							10	80	4			
WQ7	10/28/80	Silver Crk - below Buck Lake	Surface Water			8.18		457				<10							10	80	2			
WQ7	12/10/80	Silver Crk - below Buck Lake	Surface Water			7.94						<10							10		<.2			
WQ8	10/23/80	Goldsil - Upper Holding Pond (clear water)	Surface Water			8.45		438				<10							<10	210	<.2			
WQ8	10/28/80	Goldsil - Upper Holding Pond (clear water)	Surface Water			8.33		414				<10							10	190	<.2			
WQ9	10/23/80	Goldsil - Lower Tailings Pond	Surface Water			8.66		415				20							240	340	80			
WQ9	10/28/80	Goldsil - Lower Tailings Pond	Surface Water			8.50		398				40							270	240	120			
WQ10	10/28/80	Silver Crk - below Clear Pond	Surface Water			8.32		441				<10							10	120	<.2			
WQ11	12/10/80	Silver Crk - Birdseye Road	Surface Water			7.90						<10							<10		<.2			
Sawmill C	11/20/80	Sawmill Crk	Surface Water	2.0	6.3	8.43	340	415		1										60		10		
Sawmill C	09/19/81	Sawmill Crk	Surface Water	1.0	6.2	7.00	340	390.6		3									9			8		
Ottawa C	12/78	Ottawa Crk	Surface Water																	<10		<10		
Ottawa C	01/30/79	Ottawa Crk	Surface Water																	<10		<10		
Station #1	10/21/76	Silver Creek below China Gulch	Surface Water					348				10							<10		<.2			<50
Station #1	11/15/76	Silver Creek below China Gulch	Surface Water																					
Station #1	11/29/76	Silver Creek below China Gulch	Surface Water																					
Station #1	01/12/77	Silver Creek below China Gulch	Surface Water													<1			<10	90			<50	
Station #1	01/31/77	Silver Creek below China Gulch	Surface Water																					
Station #1A	01/31/77	Silver Creek near Goldsil tailings pile	Surface Water																					
Station #2A	01/12/77	Pond between mill and no trespassing access road east of mill	Surface Water													<1			<10	320			<50	
Station #2B	01/12/77	Silver Creek between mill and upper tailings pond at headgate	Surface Water													<1			<10	250			<50	
Station #3	10/21/76	Upper tailings pond	Surface Water					1191				410							8000		140			<50
Station #3	11/15/76	Upper tailings pond	Surface Water																					
Station #3	01/12/77	Upper tailings pond	Surface Water													<1			28000	20			90	
Station #6	11/15/76	Silver Creek below lower tailings pond	Surface Water																					
Station #6	11/29/76	Silver Creek below lower tailings pond	Surface Water																					
Station #6	01/12/77	Silver Creek below lower tailings pond	Surface Water													<1			10	100			<50	
Station #6	01/31/77	Silver Creek below lower tailings pond	Surface Water																					
Station #7	10/21/76	Silver Creek at gravel road 0.9 mile from Lincoln highway	Surface Water					414				10							<10		<.2			<50

Note: WQB-7 standards for metals (except aluminum) in surface water are based upon the analysis of total recoverable metals. Aluminum is based on dissolved metals.

*Based on a hardness of 200 mg/l as $CaCO_3$ (note that average hardness for previous data is 190 mg/l $CaCO_3$)

**Aquatic life standards are based on specization of Cr(III) and Cr(VI). The analyses performed were total Cr.

Table 2-10. Summary of Silver Creek Drainage Surface Water Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	Sb (ug/L) Total/Dissolved	Se (ug/L) Total/Dissolved	Zn (ug/L) Total/Dissolved	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Hardness (mg $CaCO_3$/L)	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Carbonate as CO_3 (mg/L)	Bicarbonate as HCO_3 (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	NO_3/NO_2-N (mg/L)	Total Cyanide (mg/L)	Source/Date
		WQB-7-Human Health Standard	Surface Water	6	50	2000													10000	200	
		WQB-7 Acute Aquatic Life Standard	Surface Water		20	215.6*														22	
		WQB-7 Chronic Aquatic Life Standard	Surface Water		5	215.6*														5.2	
Culvert Intake	03/27/02	Silver Crk Ranchette Rd.	Surface Water	ND		20															DEQ/MWCB, 2002
Transfer Station Rd	03/27/02	Silver Crk - at Transfer Station Rd.	Surface Water	ND		ND															DEQ/MWCB, 2002
25-200-SW-01	10/11/95	Rawhide Gulch at Ski road	Surface Water		5/5	20/20	29.0	3.0	1.0	1.0	85		111	0	98	80	2	10	0.08	0.005	Maxim, 1996
25-200-SW-01	02/08/96	Rawhide Gulch at Ski road	Surface Water		5/5	40/30	28.0	4.0	1.0	1.0	86		118	0	104	85	2	10	0.13		Maxim, 1996
25-200-SW-01	05/01/96	Rawhide Gulch at Ski road	Surface Water		5/5	20/20	26.0	3.0	1.0	1.0	77		115	0	95	78	1	9	0.16	0.005	Maxim, 1996
25-200-SW-01	08/28/96	Rawhide Gulch at Ski road	Surface Water		5/5	30/30	27.0	4.0	1.0	1.0	84		126	0	92	75	1	10	0.05	0.005	Maxim, 1996
25-200-SW-02	10/11/95	Silver Creek at Marysville	Surface Water		5/5	20/30	38.0	4.0	1.0	1.0	111		195	0	135	111	1	10	0.20	0.005	Maxim, 1996
25-200-SW-02	02/08/96	Silver Creek at Marysville	Surface Water		5/5	20/20	40.0	4.0	1.0	2.0	116		136	0	121	99	3	13	0.33	0.005	Maxim, 1996
25-200-SW-02	05/01/96	Silver Creek at Marysville	Surface Water		5/5	20/20	42.0	3.0	1.0	2.0	117		139	0	135	111	2	11	0.26	0.005	Maxim, 1996
25-200-SW-02	08/28/96	Silver Creek at Marysville	Surface Water		5/5	30/20	44.0	5.0	1.0	2.0	130		163	0	149	122	1	10	0.27	0.005	Maxim, 1996
25-200-SW-02A	08/28/96	Silver Creek immediately below Drumlummon waste rock pile	Surface Water		5/5	100/30	44.0	6.0	1.0	2.0	135		159	0	149	122	1	10	0.29	0.005	Maxim, 1996
25-200-SW-03	10/11/95	Jennies Fork; at County Road	Surface Water		5/5	30/20	48.0	6.0	10.0	1.0	145		186	0	159	130	2	21	0.88	0.005	Maxim, 1996
25-200-SW-03	02/08/96	Jennies Fork; at County Road	Surface Water		5/5	20/20	46.0	8.0	3.0	2.0	148		171	0	144	118	3	22	0.70	0.005	Maxim, 1996
25-200-SW-03	05/01/96	Jennies Fork; at County Road	Surface Water		5/5	20/20	41.0	7.0	1.0	2.0	131		182	0	144	118	3	20	0.72	0.005	Maxim, 1996
25-200-SW-04	10/11/95	Silver Creek at Skid Road (continuous recorder station)	Surface Water		5/5	30/20	52.0	5.0	1.0	1.0	150		193	0	153	125	3	18	0.43	0.005	Maxim, 1996
25-200-SW-04	02/08/96	Silver Creek at Skid Road (continuous recorder station)	Surface Water		5/5	70/20	35.0	6.0	1.0	2.0	112		88	0	110	90	5	17	0.33		Maxim, 1996
25-200-SW-04	05/01/96	Silver Creek at Skid Road (continuous recorder station)	Surface Water		5/5	20/20	45.0	4.0	1.0	2.0	129		161	0	144	118	1	17	0.5	0.005	Maxim, 1996
25-200-SW-04	08/28/96	Silver Creek at Skid Road (continuous recorder station)	Surface Water		5/5	90/40	48.0	6.0	1.0	2.0	145		179	0	154	126	1	15	0.49	0.005	Maxim, 1996
25-200-SW-05	10/11/95	Sawmill Gulch	Surface Water		5/5	30/90	53.0	13.0	1.0	1.0	186		228	0	225	184	1	18	0.05	0.005	Maxim, 1996
25-200-SW-05	02/08/96	Sawmill Gulch	Surface Water		5/5	20/20	44.0	13.0	1.0	2.0	163		145	0	167	137	1	16	0.19		Maxim, 1996
25-200-SW-05	05/01/96	Sawmill Gulch	Surface Water		5/5	20/20	55.0	14.0	1.0	2.0	195		225	6	213	184	1	17	0.18	0.005	Maxim, 1996
25-200-SW-06	10/11/95	Silver Creek immediately above reclaimed tailings channel	Surface Water		5/5	20/20	50.0	8.0	9.0	2.0	158		192	0	187	153	2	16	0.20	0.005	Maxim, 1996
25-200-SW-06	02/08/96	Silver Creek immediately above reclaimed tailings channel	Surface Water		5/5	130/20	45.0	8.0	1.0	2.0	145		108	0	161	132	1	16	0.47		Maxim, 1996
25-200-SW-06	05/01/96	Silver Creek immediately above reclaimed tailings channel	Surface Water		5/5	20/20	52.0	9.0	1.0	2.0	167		207	0	184	151	2	18	0.29	0.005	Maxim, 1996
25-200-SW-06	08/28/96	Silver Creek immediately above reclaimed tailings channel	Surface Water		5/5	20/20	53.0	9.0	1.0	2.0	169		199	0	188	154	1	16	0.26	0.005	Maxim, 1996
25-200-SW-07	10/11/95	Silver Creek at Goldsil, second culvert	Surface Water		5/5	80/20	64.0	13.0	1.0	2.0	213		250	0	250	205	3	15	0.01	0.005	Maxim, 1996
25-200-SW-07	10/11/95	Duplicate 25-200-SW-07 (10/11/95)	Surface Water		5/5	20/30	64.0	14.0	1.0	2.0	217		262	0	254	208	3	15	0.01	0.005	Maxim, 1996
25-200-SW-07	02/08/96	Silver Creek at Goldsil, second culvert	Surface Water		5/5	70/20	44.0	9.0	1.0	3.0	147		161	0	161	132	3	14	0.15	0.005	Maxim, 1996
25-200-SW-07	05/01/96	Silver Creek at Goldsil, second culvert	Surface Water		5/5	20/20	49.0	12.0	1.0	2.0	172		216	6	190	165	1	18	0.10	0.005	Maxim, 1996
25-200-SW-07	05/01/96	Duplicate 25-200-SW-07 (05/01/96)	Surface Water		5/5	20/20	54.0	11.0	1.0	2.0	180		209	6	201	165	2	18	0.11	0.005	Maxim, 1996
25-200-SW-07	08/28/96	Silver Creek at Goldsil, second culvert	Surface Water		5/5	40/40	59.0	13.0	1.0	2.0	201		230	0	234	192	1	14	0.06	0.005	Maxim, 1996
25-200-SW-08	10/11/95	Sitzer Gulch at Birdseye Road	Surface Water		5/5	20/20	90.0	40.0	30.0	3.0	389		552	0	345	283	9	142	0.01	0.007	Maxim, 1996
25-200-SW-08	02/08/96	Sitzer Gulch at Birdseye Road	Surface Water		5/5	80/20	20.0	8.0	1.0	8.0	83		67	0	81	66	2	33	0.16	0.005	Maxim, 1996
25-200-SW-08	05/01/96	Sitzer Gulch at Birdseye Road	Surface Water		5/5	20/20	75.0	36.0	16.0	4.0	336		462	0	305	250	9	128	0.06	0.005	Maxim, 1996
25-200-SW-09	10/11/95	Silver Creek at railroad trestle below Sitzer (continous recorder sta.)	Surface Water		5/5	110/20	64.0	18.0	4.0	2.0	234		279	0	259	212	3	31	0.01	0.005	Maxim, 1996
25-200-SW-09	02/08/96	Silver Creek at railroad trestle below Sitzer (continous recorder sta.)	Surface Water		5/5	60/20	21.0	8.0	1.0	6.0	85		102	0	81	66	3	24	0.09		Maxim, 1996
25-200-SW-09	05/01/96	Silver Creek at railroad trestle below Sitzer (continous recorder sta.)	Surface Water		5/5	20/20	51.0	18.0	1.0	3.0	201		244	6	213	184	2	27	0.03	0.005	Maxim, 1996
25-200-SW-09	08/28/96	Silver Creek at railroad trestle below Sitzer (continous recorder sta.)	Surface Water		5/5	60/30	56.0	17.0	1.0	2.0	210		251	0	245	201	3	10	0.05	0.009	Maxim, 1996
25-200-SW-10	10/11/95	Threemile Creek	Surface Water		5/5	20/40	43.0	24.0	12.0	1.0	206		228	0	245	201	2	16	0.01	0.005	Maxim, 1996
25-200-SW-10	02/08/96	Threemile Creek	Surface Water		5/5	60/20	12.0	4.0	1.0	3.0	46		38	0	57	47	2	8	0.21	0.005	Maxim, 1996
25-200-SW-10	05/01/96	Threemile Creek	Surface Water		5/5	20/20	40.0	25.0	4.0	2.0	203		224	0	225	184	2	17	0.04	0.005	Maxim, 1996
25-200-SW-11	10/11/95	Silver Creek at Silver Creek Estates Road	Surface Water		5/5	20/20	98.0	35.0	29.0	4.0	389		555	0	366	300	10	132	0.05	0.005	Maxim, 1996
25-200-SW-11	02/08/96	Silver Creek at Silver Creek Estates Road	Surface Water		5/5	60/20	19.0	6.0	2.0	8.0	72		123	0	74	61	2	21	0.20		Maxim, 1996
25-200-SW-11	02/08/96	Duplicate 25-200-SW-11 (02/08/96)	Surface Water		5/5	50/20	18.0	6.0	2.0	6.0	70		142	0	74	61	4	21	0.14	0.005	Maxim, 1996
25-200-SW-11	05/01/96	Silver Creek at Silver Creek Estates Road	Surface Water		5/5	20/20	71.0	30.0	8.0	4.0	301		377	6	265	227	5	85	0.03	0.005	Maxim, 1996
25-200-SW-11	08/28/96	Silver Creek at Silver Creek Estates Road	Surface Water		5/5	60/50	112.0	48.0	22.0	5.0	477		646	0	411	337	9	169	0.05	0.009	Maxim, 1996
25-200-SW-11	08/28/96	Duplicate 25-200-SW-11 (08/28/96)	Surface Water		5/5	60/30	109.0	47.0	21.0	5.0	466		656	0	417	342	9	170	0.05	0.005	Maxim, 1996
25-365-SW-1	09/02/93	Goldsil Millsite - at toe of berm w/flow gate in Silver Crk	Surface Water	31.7		8.71					212		213				<5	19	<0.05	<0.005	MDSL/AMRB, 1993a
25-365-SW-2	09/02/93	Goldsil Millsite - Silver Crk at culvert (downgradient) at rd.	Surface Water	31.7		12.3					195		212				<5	18	0.06	<0.005	MDSL/AMRB, 1993a
25-365-SW-3	09/02/93	Goldsil Millsite - Silver Crk upgradient (200') from Argo mill bldg.	Surface Water	31.7		12.4					181		189				<5	18	0.09	<0.005	MDSL/AMRB, 1993a
25-365-SW-5	09/02/93	Goldsil Millsite - pregnant pond below mill	Surface Water																	<0.005	MDSL/AMRB, 1993a
25-024-AD1	6/23-24/93	Drumlummon - Adit discharge on WR4	Surface Water	29.4		6.07					319		309				<5	24	<0.05		MDSL/AMRB, 1993b
25-024-SW1	6/23-24/93	Drumlummon - Ottawa Gulch (Silver Crk) upstream of mines and mills	Surface Water	29.4		6.67					144		137				<5	8.0	0.15		MDSL/AMRB, 1993b
25-024-SW2	6/23-24/93	Drumlummon - Silver Crk below mines, mills and TP1	Surface Water	29.4		4.5					139		148				<5	12	0.16		MDSL/AMRB, 1994
25-024-SW3	6/23-24/93	Drumlummon - Silver Crk below tailings TP2, two miles below mills	Surface Water	29.4		13.7					188		177.00				<5	18	0.14		MDSL/AMRB, 1994
SW-1	07/08/88	Goldsil Millsite - Silver Crk 3 mi. west of lower gate	Surface Water																	0	MDHES, 1988
SW-2	07/08/88	Goldsil Millsite - Silver Crk 0.9 mi. west of lower gate	Surface Water																	0	MDHES, 1988
SW-3	07/08/88	Goldsil Millsite - Silver Crk at upstream entrance to site	Surface Water	0	0	0	53.2	8.35	0	0										0	MDHES, 1988
SW-4	07/08/88	Goldsil Millsite - Silver Crk N.E. corner of upper lagoon	Surface Water																	0	MDHES, 1988
SW-5	07/08/88	Goldsil Millsite - Silver Crk at downstream entrance to site	Surface Water	0	0	0	58.0	12.3	0	0										0.005	MDHES, 1988
SW-6	07/08/88	Goldsil Millsite - Silver Crk just below lower lagoon	Surface Water																	0	MDHES, 1988

Table 2-10. Summary of Silver Creek Drainage Surface Water Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	Sb (ug/L) Total/Dissolved	Se (ug/L) Total/Dissolved	Zn (ug/L) Total/Dissolved	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Hardness (mg $CaCO_3$/L)	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Carbonate as CO_3 (mg/L)	Bicarbonate as HCO_3 (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	NO_3/NO_2-N (mg/L)	Total Cyanide (mg/L)	Source/Date
		WQB-7-Human Health Standard	Surface Water	6	50	2000													10000	200	
		WQB-7 Acute Aquatic Life Standard	Surface Water		20	215.6*														22	
		WQB-7 Chronic Aquatic Life Standard	Surface Water		5	215.6*														5.2	
SW-7	07/08/88	Goldsil Millsite - Silver Crk just below Buck Lake	Surface Water																	0	MDHES, 1988
LL-1	07/08/88	Goldsil Millsite - spring below the lower lagoon	Surface Water	0	0	0	69.4	22.9	8.21	0										1.690	MDHES, 1988
ML-1	07/08/88	Goldsil Millsite - lagoon just north of mill	Surface Water	0	0	38	15.2	5.0	0	0										0	MDHES, 1988
UL-1	07/08/88	Goldsil Millsite - lagoon upstream from mill	Surface Water	276	12.5	2040	17.2	5.11	154	16.8										0.325	MDHES, 1988
H7	12/07/81	Silver Crk - above Maskelyne Tunnel; above mine office entrance road	Surface Water		<5/<5	<10/<10	39	5	4	2	117	10	133.00	0	131.00	108.00	17	1			Goldsil Mining and Milling, Inc., 1984
H7	06/10/82	Silver Crk - above Maskelyne Tunnel; above mine office entrance road	Surface Water			<10														0.408	Hydrometrics, 1983
H7	10/25/82	Silver Crk - above Maskelyne Tunnel; above mine office entrance road	Surface Water			<10/<10															Hydrometrics, 1983
H7	12/14/83	Silver Crk - above Maskelyne Tunnel; above mine office entrance road	Surface Water																		Hydrometrics, 1983
H9	10/21/81	Ottawa Gulch just above Obie Adit	Surface Water		<5/<5	10/10	47	5	1	2	134	<1	143	0	147	120	13	2			Goldsil Mining and Milling, Inc., 1984
H11	12/14/83	Jennies Fork; at county road bridge	Surface Water																		Hydrometrics, 1983
H12	12/14/83	Silver Creek; below Jennies Fork	Surface Water																		Hydrometrics, 1983
H13	12/14/83	Silver Creek above Sawmill Gulch	Surface Water																		Hydrometrics, 1983
H14	12/14/83	Sawmill Gulch above Silver Creek	Surface Water																		Hydrometrics, 1983
FG1/H15	10/21/76	Silver Creek; below China Gulch	Surface Water			<10	55	9.9	4.0	1.8						171	0.21	12		<20	Goldsil Mining and Milling, Inc., 1984
FG1/H15	11/15/74	Silver Creek; below China Gulch	Surface Water																	<2	Goldsil Mining and Milling, Inc., 1984
FG1/H15	11/29/76	Silver Creek; below China Gulch	Surface Water																	<1	Goldsil Mining and Milling, Inc., 1984
FG1/H16	10/21/76	Silver Creek; below China Gulch	Surface Water			<10	56	17	5.5	2.0						201	3.3	13			Goldsil Mining and Milling, Inc., 1984
H17	11/23/74	Silver Creek above China Gulch	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H18	11/23/76	Silver Creek above China Gulch	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H19	11/23/76	Silver Creek above China Gulch	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H20	11/23/76	China Gulch above Silver Creek	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H21	11/23/76	Silver Creek; below China Gulch	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H22	11/23/76	Silver Creek above tailings	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H23	11/23/76	Silver Creek above tailings	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H24	11/23/76	Silver Creek at Mill	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H25	11/23/76	Silver Creek below Mill	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H26	11/23/76	Silver Creek near Clear Pond	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H27	11/23/76	Silver Creek above gravel road	Surface Water																		Goldsil Mining and Milling, Inc., 1984
H28	11/23/76	Silver Creek above Sitzer	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ1/H6	09/17/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water			<5/6	54.6	10.1			178			0.0	173.2	142	1.2	17.1			Goldsil Mining and Milling, Inc., 1984
WQ1/H6	10/23/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water				51.4	10.0			170			0.0	186.7	153	1.4			0.009	Goldsil Mining and Milling, Inc., 1984
WQ1/H6	10/28/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water				59.9	9.1			187			0.0	187.9	154	1.4			<0.005	Goldsil Mining and Milling, Inc., 1984
WQ1/H6	10/29/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water						4											<0.005	Goldsil Mining and Milling, Inc., 1984
WQ1/H6	10/30/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water																	<0.005	Goldsil Mining and Milling, Inc., 1984
WQ1/H6	12/10/80	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water																	<0.001	Goldsil Mining and Milling, Inc., 1984
WQ1/H6	06/30/81	Silver Crk - above Goldsil; at culvert at mill office entrance road	Surface Water						5											<0.005	Goldsil Mining and Milling, Inc., 1984
WQ2/H5	10/09/80	Silver Crk - at entrance to Goldsil mill	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ2/H5	10/15/80	Silver Crk - at entrance to Goldsil mill	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ2/H5	10/23/80	Silver Crk - at entrance to Goldsil mill	Surface Water				59.1	15.4			211			0.0	226.9	186	1.7			0.010	Goldsil Mining and Milling, Inc., 1984
WQ2/H5	10/28/80	Silver Crk - at entrance to Goldsil mill	Surface Water				64.8	13.6			218			0.0	219.6	180				<0.005	Goldsil Mining and Milling, Inc., 1984
WQ2/H5	10/29/80	Silver Crk - at entrance to Goldsil mill	Surface Water						5											0.019	Goldsil Mining and Milling, Inc., 1984
WQ2/H5	06/30/81	Silver Crk - at entrance to Goldsil mill	Surface Water						5											<0.005	Goldsil Mining and Milling, Inc., 1984
WQ2/H5	06/10/82	Silver Crk - at entrance to Goldsil mill	Surface Water																	0.011	Hydrometrics, 1983
WQ2/H5	10/25/82	Silver Crk - at entrance to Goldsil mill	Surface Water																	<0.005	Hydrometrics, 1983
WQ2/H5	11/16/83	Silver Crk - at entrance to Goldsil mill	Surface Water																	<0.005	Hydrometrics, 1983
WQ12/H4	10/09/80	Silver Crk - above Upper Pond	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ12/H4	10/15/80	Silver Crk - above Upper Pond	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ12/H4	10/29/80	Silver Crk - above Upper Pond	Surface Water						5											<0.005	Goldsil Mining and Milling, Inc., 1984
WQ12/H4	06/30/81	Silver Crk - above Upper Pond	Surface Water						5											<0.005	Goldsil Mining and Milling, Inc., 1984
WQ10	10/28/80	Silver Crk - between Upper & Lower Ponds	Surface Water				63.5	15.9			224			0.0	229.4	188	1.9			<0.005	Goldsil Mining and Milling, Inc., 1984
WQ3/H3	10/09/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ3/H3	10/15/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ3/H3	10/23/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water				60.9	14.5			212			0.0	245.2	201	3.2			0.15	Goldsil Mining and Milling, Inc., 1984
WQ3/H3	10/28/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water				66.8	16.8			236			0.0	234.2	192	2.3			0.028	Goldsil Mining and Milling, Inc., 1984
WQ3/H3	12/10/80	Silver Crk - above seep; opposite White's tailings pond	Surface Water																	0.021	Goldsil Mining and Milling, Inc., 1984
WQ5	10/09/80	Silver Crk - below seep	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ5	10/15/80	Silver Crk - below seep	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ5	10/23/80	Silver Crk - below seep	Surface Water				65.1	26.7			272			0.0	246.4	202	4.5			0.10	Goldsil Mining and Milling, Inc., 1984
WQ5	10/28/80	Silver Crk - below seep	Surface Water				65.4	16.8			232			0.0	233.0	191	2.8			0.051	Goldsil Mining and Milling, Inc., 1984

Table 2-10. Summary of Silver Creek Drainage Surface Water Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	Sb (ug/L) Total/Dissolved	Se (ug/L) Total/Dissolved	Zn (ug/L) Total/Dissolved	Ca (mg/L)	Mg (mg/L)	Na (mg/L)	K (mg/L)	Hardness (mg $CaCO_3$/L)	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Carbonate as CO_3 (mg/L)	Bicarbonate as HCO_3 (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	NO_3/NO_2-N (mg/L)	Total Cyanide (mg/L)	Source/Date
		WQB-7-Human Health Standard	Surface Water	6	50	2000													10000	200	
		WQB-7 Acute Aquatic Life Standard	Surface Water		20	215.6*														22	
		WQB-7 Chronic Aquatic Life Standard	Surface Water		5	215.6*														5.2	
WQ5	12/10/80	Silver Crk - below seep	Surface Water																	0.029	Goldsil Mining and Milling, Inc., 1984
WQ6/H2	11/15/76	Silver Crk - below seep	Surface Water																	0.010	Goldsil Mining and Milling, Inc., 1984
WQ6/H2	11/29/76	Silver Crk - below seep	Surface Water																	0.008	Goldsil Mining and Milling, Inc., 1984
WQ6/H2	09/17/80	Silver Crk - above Buck Lake	Surface Water			<5/20	55.9	15.3			202			0.0	224.5	184	2.8	21.4		0.117	Goldsil Mining and Milling, Inc., 1984
WQ6/H2	10/09/80	Silver Crk - above Buck Lake	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ6/H2	10/15/80	Silver Crk - above Buck Lake	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ6/H2	10/23/80	Silver Crk - above Buck Lake	Surface Water				63.3	18.2			233			0.0	245.2	201	4.4			0.10	Goldsil Mining and Milling, Inc., 1984
WQ6/H2	10/28/80	Silver Crk - above Buck Lake	Surface Water				65.6	15.4			227			0.0	233.0	191	2.9			0.041	Goldsil Mining and Milling, Inc., 1984
WQ6/H2	10/29/80	Silver Crk - above Buck Lake	Surface Water						9											0.062	Goldsil Mining and Milling, Inc., 1984
WQ6/H2	06/30/81	Silver Crk - above Buck Lake	Surface Water						6											<0.005	Goldsil Mining and Milling, Inc., 1984
WQ6/H2	06/21/82	Silver Crk - above Buck Lake	Surface Water																	0.011	Hydrometrics, 1983
WQ6/H2	10/25/82	Silver Crk - above Buck Lake	Surface Water																	0.009	Hydrometrics, 1983
WQ4/H1	09/17/80	Silver Crk - seep	Surface Water			10/10	61.5	19.7			235			0.0	251.3	206	70.3	106.0		8.6	Goldsil Mining and Milling, Inc., 1984
WQ4/H1	10/23/80	Silver Crk - seep	Surface Water				62.1	20.0			237			0.0	263.0	232	44.4			2.0	Goldsil Mining and Milling, Inc., 1984
WQ4/H1	10/28/80	Silver Crk - seep	Surface Water				67.2	18.2			243			0.0	273.3	224	40.4			1.31	Goldsil Mining and Milling, Inc., 1984
WQ4/H1	10/29/80	Silver Crk - seep	Surface Water						65											0.98	Goldsil Mining and Milling, Inc., 1984
WQ4/H1	10/29/80	Silver Crk - seep	Surface Water																	0.86	Goldsil Mining and Milling, Inc., 1984
WQ4/H1	12/10/80	Silver Crk - seep	Surface Water																	0.462	Goldsil Mining and Milling, Inc., 1984
WQ4/H1	06/30/81	Silver Crk - seep	Surface Water						33											0.15	Goldsil Mining and Milling, Inc., 1984
WQ4/H1	06/30/81	Silver Crk - seep	Surface Water						34											0.17	Goldsil Mining and Milling, Inc., 1984
WQ4/H1	06/21/82	Silver Crk - seep	Surface Water																	0.408	Hydrometrics, 1983
WQ4/H1	10/25/82	Silver Crk - seep	Surface Water																	0.354	Hydrometrics, 1983
WQ4/H1	10/25/82	Silver Crk - seep	Surface Water																	0.009	Hydrometrics, 1983
WQ7	10/09/80	Silver Crk - below Buck Lake	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ7	10/23/80	Silver Crk - below Buck Lake	Surface Water				62.3	18.6			232			0.0	236.7	194	4.3			0.020	Goldsil Mining and Milling, Inc., 1984
WQ7	10/28/80	Silver Crk - below Buck Lake	Surface Water				65.3	17.7			236			0.0	230.6	189	3.3			0.075	Goldsil Mining and Milling, Inc., 1984
WQ7	12/10/80	Silver Crk - below Buck Lake	Surface Water																		Goldsil Mining and Milling, Inc., 1984
WQ8	10/23/80	Goldsil - Upper Holding Pond (clear water)	Surface Water				59.0	15.3			210			0.0	229.4	188	1.8			0.7	Goldsil Mining and Milling, Inc., 1984
WQ8	10/28/80	Goldsil - Upper Holding Pond (clear water)	Surface Water				67.5	14.1			227			0.0	220.8	181	1.9			<0.005	Goldsil Mining and Milling, Inc., 1984
WQ9	10/23/80	Goldsil - Lower Tailings Pond	Surface Water				57.1	14.5			202			0.0	194.0	139	3.3			0.29	Goldsil Mining and Milling, Inc., 1984
WQ9	10/28/80	Goldsil - Lower Tailings Pond	Surface Water				47.3	13.6			174			0.0	187.9	154	4.1			0.328	Goldsil Mining and Milling, Inc., 1984
WQ10	10/28/80	Silver Crk - below Clear Pond	Surface Water				63.5	15.9			224			0.0	229.4	188	1.9			<0.005	Goldsil Mining and Milling, Inc., 1984
WQ11	12/10/80	Silver Crk - Birdseye Road	Surface Water																		Goldsil Mining and Milling, Inc., 1984
Sawmill C	11/20/80	Sawmill Crk	Surface Water				61.8	14.8	1.9	2.6	215.23	5.39	231.4	1.7	235	195.58	1.5	21.2	0.07		Goldsil Mining and Milling, Inc., 1984
Sawmill C	09/19/81	Sawmill Crk	Surface Water				56.4	14.4	2.0	2.5	200.10	29.5	219.05	0	225	184.54	1.0	22.2	0.084		Goldsil Mining and Milling, Inc., 1984
Ottawa C	12/78	Ottawa Crk	Surface Water				45.9	4.3	2.2	2.1				0	149.0		0.65	14.2	0.418		Goldsil Mining and Milling, Inc., 1984
Ottawa C	01/30/79	Ottawa Crk	Surface Water				46.8	4.4	2.3	2.2				0	146		8	16.2	0.474		Goldsil Mining and Milling, Inc., 1984
Station #1	10/21/76	Silver Creek below China Gulch	Surface Water			<10	55	9.9	4.0	1.8						171	0.21	12		<0.02	MT Dept. of Fish and Game, 1977
Station #1	11/15/76	Silver Creek below China Gulch	Surface Water																	<0.002	MT Dept. of Fish and Game, 1977
Station #1	11/29/76	Silver Creek below China Gulch	Surface Water																	0.001	MT Dept. of Fish and Game, 1977
Station #1	01/12/77	Silver Creek below China Gulch	Surface Water			<10														<0.001	MT Dept. of Fish and Game, 1977
Station #1	01/31/77	Silver Creek below China Gulch	Surface Water																	0.002	MT Dept. of Fish and Game, 1977
Station #1A	01/31/77	Silver Creek near Goldsil tailings pile	Surface Water																	<0.001	MT Dept. of Fish and Game, 1977
Station #2A	01/12/77	Pond between mill and no trespassing access road east of mill	Surface Water			<10														0.008	MT Dept. of Fish and Game, 1977
Station #2B	01/12/77	Silver Creek between mill and upper tailings pond at headgate	Surface Water			<10														<0.001	MT Dept. of Fish and Game, 1977
Station #3	10/21/76	Upper tailings pond	Surface Water			680	89	51	93	39						237	148	230		6.5	MT Dept. of Fish and Game, 1977
Station #3	11/15/76	Upper tailings pond	Surface Water																	6.95	MT Dept. of Fish and Game, 1977
Station #3	01/12/77	Upper tailings pond	Surface Water			6500														22.0	MT Dept. of Fish and Game, 1977
Station #6	11/15/76	Silver Creek below lower tailings pond	Surface Water																	0.010	MT Dept. of Fish and Game, 1977
Station #6	11/29/76	Silver Creek below lower tailings pond	Surface Water																	0.008	MT Dept. of Fish and Game, 1977
Station #6	01/12/77	Silver Creek below lower tailings pond	Surface Water			<10															MT Dept. of Fish and Game, 1977
Station #6	01/31/77	Silver Creek below lower tailings pond	Surface Water																	0.008	MT Dept. of Fish and Game, 1977
Station #7	10/21/76	Silver Creek at gravel road 0.9 mile from Lincoln highway	Surface Water			<10	56	17	5.5	2.0						201	3.3	13		<0.02	MT Dept. of Fish and Game, 1977

Note: WQB-7 standards for metals (except aluminum) in surface water are based upon the analysis of total recoverable metals.
Aluminum is based on dissolved metals.

*Based on a hardness of 200 mg/l as $CaCO_3$ (note that average hardness for previous data is 190 mg/l $CaCO_3$)

**Aquatic life standards are based on specization of Cr(III) and Cr(VI). The analyses performed were total Cr.

Table 2-11. Summary of Previous Silver Creek Drainage Groundwater and Adit Discharge Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	Well Depth (ft.)	Aquifer	Discharge (cfs)	Field pH (s.u.)	Lab pH (s.u.)	Field Specific Conductivity (umhos/cm)	Lab Specific Conductivity (umhos/cm)	Lab Turbidity (JTU)
		WQB-7 Ground Water Human Health Standard	Groundwater								
PIPINICH 25-200-GW-1	10/11/95	Pipinich Residence	Groundwater	75	Granite Bedrock		7.0	7.4	238	291	
PIPINICH 25-200-GW-1	05/01/96	Pipinich Residence	Groundwater	75	Granite Bedrock		6.6	7.1	353	329	
HULL 25-200-GW-2	10/11/95	Hull Residence	Groundwater	155	Granite Bedrock		6.9	7.8	216	281	
HULL 25-200-GW-2	05/01/96	Hull Residence	Groundwater	155	Granite Bedrock		6.0	7.3	294	285	
M-VILLE 25-200-GW-3	10/11/95	Marysville House	Groundwater	28	Alluvium		6.8	7.3	163	212	
HALL 25-200-GW-4	10/11/95	Hall Residence	Groundwater	105	Granite Bedrock		6.8	7.8	238	257	
HALL 25-200-GW-4	05/01/96	Hall Residence	Groundwater	105	Granite Bedrock		7.2	7.3	181	216	
25-200-PS-01	10/11/95	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge			0.27	8.1	8.3	256	237	
25-200-PS-01	02/08/96	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge			0.2	7.7	7.6	245	241	
25-200-PS-01	05/01/96	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge			0.34	7.7	7.8	356	253	
25-200-PS-01A	10/11/95	Bald Mountain (at black pipe draining adit to storage tank)	Adit Discharge			0.13	7.8	8.1	240	217	
25-200-PS-02	10/11/95	Drumlummon adit	Adit Discharge			0.1	7.7	8.0	605	528	
25-200-PS-02	02/08/96	Drumlummon adit	Adit Discharge			0.08	7.5	7.2	571	283	
25-200-PS-02	05/01/96	Drumlummon adit	Adit Discharge			0.07	6.4	7.8	603	526	
Adit #1	07/17/96	Belmont Mine adit	Adit Discharge								
Adit #18	07/17/96	Collapsed mine adit near the ski base area	Adit Discharge								
Adit #2	07/17/96	Belmont Mine adit	Adit Discharge								
25-024-AD1	6/23-24/94	Drumlummon Mill; adit discharge on WR4	Adit Discharge								
H8	08/27/81	Maskelyne Tunnel discharge at culvert	Adit Discharge					7.0		449	4.4
H8	12/07/81	Maskelyne Tunnel discharge at culvert	Adit Discharge					7.3		557	5.9
H10	10/21/81	Obie adit discharge	Adit Discharge			0.009		7.2	287	269	0.56
TP #1	10/06/83	Tailings Pond Groundwater Monitoring System, Site #1	Groundwater								
TP #2	10/06/83	Tailings Pond Groundwater Monitoring System, Site #2	Groundwater					7.7		525	
TP #4	10/06/83	Tailings Pond Groundwater Monitoring System, Site #4	Groundwater					7.3		455	
TP #5	10/06/83	Tailings Pond Groundwater Monitoring System, Site #5	Groundwater					7.2		452	
TP #1 SEEP	11/16/83	Seep near Tailings Pond Groundwater Monitoring System, Site #1	Groundwater								
W-8	12/13/83	Robert O'Connell residence, Marysville	Groundwater					6.7		260	0.44
W-22	12/13/83	Thomas residence, Marysville	Groundwater								
W-35	12/13/83	Goldsil Mining and Milling, Inc., mill office supply well	Groundwater								
E MILLER	10/21/81	Emma Miller Mine (shaft)	Groundwater					7.2		223	0.60
DRUMLUMMON	01/08/82	Drumlummon Mine No.1 shaft (28 ft. below water surface)	Groundwater					7.4		560	6.7
GW-1	9/2/87	Sump connecting four wells near the upstream tailings pond	Groundwater								
Station #5	11/29/76	Seep into Silver Creek between upper and lower tailings ponds	Groundwater								
Station #5	01/12/77	Seep into Silver Creek between upper and lower tailings ponds	Groundwater								
Station #5A	01/26/77	Seep into Silver Creek at lower tailings pond; western portion	Groundwater								
Station #5A	01/31/77	Seep into Silver Creek at lower tailings pond; western portion	Groundwater								
Station #5B	01/26/77	Seep into Silver Creek at lower tailings pond; eastern portion	Groundwater								
Station #5B	01/31/77	Seep into Silver Creek at lower tailings pond; eastern portion	Groundwater								

Sample Station	Sample Date	Water Temp (C)	Oxidation Reduction Potential (mv)	Ag (ug/L) Total/Dissolved	Al (ug/L) Total/Dissolved	As (ug/L) Total/Dissolved	Ba (ug/L) Total/Dissolved
WQB-7 Ground Water Human Health Standard				100		20	2000
PIPINICH 25-200-GW-1	10/11/95	7.0		/50	/200	/1	/200
PIPINICH 25-200-GW-1	05/01/96	7.5		/50	/200	/1	/200
HULL 25-200-GW-2	10/11/95	7.0		/50	/200	/1	/200
HULL 25-200-GW-2	05/01/96	6.0		/50	/200	/2	/200
M-VILLE 25-200-GW-3	10/11/95	6.0		/50	/200	/1	/200
HALL 25-200-GW-4	10/11/95	10.0		/50	/200	/1	/200
HALL 25-200-GW-4	05/01/96	8.0		/50	/200	/1	/200
25-200-PS-01	10/11/95	8.0	+150	50/50	200/200	4/4	200/200
25-200-PS-01	02/08/96	6.0		50/50	200/200	4/3	200/200
25-200-PS-01	05/01/96	5.0		50/50	200/200	2/2	200/200
25-200-PS-01A	10/11/95	8.5	+195	50/50	200/200	5/4	200/200
25-200-PS-02	10/11/95	11.0	-75	50/50	200/200	20/18	200/200
25-200-PS-02	02/08/96	6.0		50/50	300/200	16/16	200/200
25-200-PS-02	05/01/96	8.0		50/50	200/200	21/21	200/200
Adit #1	07/17/96	8.0		20	2800	3	100
Adit #18	07/17/96	5.0		20	200	2	100
Adit #2	07/17/96	5.0		20	200	2	100
25-024-AD1	6/23-24/94			0.14		34.9	128
H8	08/27/81			<5	100	<5	100
H8	12/07/81			<5	<100	33	200
H10	10/21/81	4.8		<5/<5	<100/<100	<5/<5	<100/<100
TP #1	10/06/83						
TP #2	10/06/83						
TP #4	10/06/83						
TP #5	10/06/83						
TP #1 SEEP	11/16/83						
W-8	12/13/83				/<100		
W-22	12/13/83				/<100		
W-35	12/13/83				/<100		
E MILLER	10/21/81			<5/<5	<100/<100	<5/<5	<100/<100
DRUMLUMMON	01/08/82			<5/<5	100/100	37/15	<100/<100
GW-1	9/2/87						
Station #5	11/29/76						
Station #5	01/12/77						
Station #5A	01/26/77						
Station #5A	01/31/77						
Station #5B	01/26/77						
Station #5B	01/31/77						

Note: WQB-7 standards for metals in groundwater are based upon the dissolved portion of the sample (after filtration through a 0.045 um membrane filter)

Table 2-11. Summary of Previous Silver Creek Drainage Groundwater and Adit Discharge Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	Cd (ug/L) Total/Dissolved	Co (ug/L)	Cr (ug/L) Total/Dissolved	Cu (ug/L) Total/Dissolved	Fe (ug/L) Total/Dissolved	Hg (ug/L) Total/Dissolved	Mn (ug/L) Total/Dissolved	Ni (ug/L) Total/Dissolved	Pb (ug/L) Total/Dissolved	Sb (ug/L) Total/Dissolved	Se (ug/L) Total/Dissolved	V (ug/L) Total/Dissolved	Zn (ug/L) Total/Dissolved	Ca (mg/L)	Mg (mg/L)	Na (mg/L)
		WQB-7 Ground Water Human Health Standard	Groundwater	5		100	1300	300	2	50	100	15	6	50		2000			
PIPINICH 25-200-GW-1	10/11/95	Pipinich Residence	Groundwater	/0.2		/10	/3	/50	/0.2	/15	/2	/1		/5		/50	48.0	6.0	5.0
PIPINICH 25-200-GW-1	05/01/96	Pipinich Residence	Groundwater	/0.2		/10	/5	/50	/0.2	/15	/2	/1		/5		/50	50.0	8.0	1.0
HULL 25-200-GW-2	10/11/95	Hull Residence	Groundwater	/0.2		/10	/28	/50	/0.2	/15	/2	/1		/5		/20	52.0	4.0	5.0
HULL 25-200-GW-2	05/01/96	Hull Residence	Groundwater	/0.2		/10	/16	/50	/0.2	/15	/2	/1		/5		/30	46.0	6.0	1.0
M-VILLE 25-200-GW-3	10/11/95	Marysville House	Groundwater	/0.2		/10	/50	/50	/0.2	/15	/2	/1		/5		/20	26.0	4.0	9.0
HALL 25-200-GW-4	10/11/95	Hall Residence	Groundwater	/0.2		/10	/10	/50	/0.2	/15	/2	/1		/5		/20	1.0	1.0	54.0
HALL 25-200-GW-4	05/01/96	Hall Residence	Groundwater	/0.2		/10	/5	/50	/0.2	/15	/2	/1		/5		/20	1.0	1.0	43.0
25-200-PS-01	10/11/95	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge	.2/.2		10/10	1/1	100/50	.2/.2	15/15	2/2	1/1		5/5		20/20	41.0	4.0	2.0
25-200-PS-01	02/08/96	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge	.2/.2		10/10	5/5	150/50	.2/.2	23/15	2/2	1/1		5/5		70/20	43.0	4.0	1.0
25-200-PS-01	05/01/96	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge	.2/.2		10/10	5/5	130/50	.2/.2	16/15	2/2	1/1		5/5		30/20	39.0	5.0	1.0
25-200-PS-01A	10/11/95	Bald Mountain (at black pipe draining adit to storage tank)	Adit Discharge	.2/.2		10/10	1/1	50/50	.2/.2	15/15	2/2	1/1		5/5		70/140	39.0	4.0	3.0
25-200-PS-02	10/11/95	Drumlummon adit	Adit Discharge	.2/.2		10/10	1/1	900/310	.2/.2	0	2/2	1/1		5/5		20/20	76.0	22.0	13.0
25-200-PS-02	02/08/96	Drumlummon adit	Adit Discharge	.2/.2		10/10	5/5	3050/340	.2/.2	0	2/2	1/1		5/5		70/20	77.0	23.0	2.0
25-200-PS-02	05/01/96	Drumlummon adit	Adit Discharge	.2/.2		10/10	5/5	1220/560	.2/.2	0	2/2	2/1		5/5		20/20	60.0	29.0	1.0
Adit #1	07/17/96	Belmont Mine adit	Adit Discharge			10	5	2330	0.2	100		1		5		90			
Adit #18	07/17/96	Collapsed mine adit near the ski base area	Adit Discharge			10	5	240	0.2	10		1		5		40			
Adit #2	07/17/96	Belmont Mine adit	Adit Discharge			10	5	60	0.2	10		1		5		70			
25-024-AD1	6/23-24/94	Drumlummon Mill; adit discharge on WR4	Adit Discharge	2.6	8.7	4.7	4.6	2140	0.11	1640	8.0	2.1	29.4			6.07			
H8	08/27/81	Maskelyne Tunnel discharge at culvert	Adit Discharge	<1		<20	<10	1160	<1	1700		<10		<5		150	84	22	8
H8	12/07/81	Maskelyne Tunnel discharge at culvert	Adit Discharge	<1		<20	10	1430	<.2	1860		<10		<5		10	80	24	8
H10	10/21/81	Obie adit discharge	Adit Discharge	<1/<1		<20/<20	<10/<10	60/<30	<.2/<.2	20/20		<10/<10		<5/<5		10/<10	53	6	2
TP #1	10/06/83	Tailings Pond Groundwater Monitoring System, Site #1	Groundwater																
TP #2	10/06/83	Tailings Pond Groundwater Monitoring System, Site #2	Groundwater						<.2								74	19	6
TP #4	10/06/83	Tailings Pond Groundwater Monitoring System, Site #4	Groundwater						<.2								72	18	7
TP #5	10/06/83	Tailings Pond Groundwater Monitoring System, Site #5	Groundwater						0.8								70	18	6
TP #1 SEEP	11/16/83	Seep near Tailings Pond Groundwater Monitoring System, Site #1	Groundwater																
W-8	12/13/83	Robert O'Connell residence, Marysville	Groundwater	/<10			/110	/<30	/<1	/<20	/<30	/<10		/<5	/<100	/10	39	7	3
W-22	12/13/83	Thomas residence, Marysville	Groundwater	/<10			/50	/<30	/<1	/<20	/<30	/<10		/<5	/<100	/20			
W-35	12/13/83	Goldsil Mining and Milling, Inc., mill office supply well	Groundwater	/<10			/<10	/3100	/<1	/60	/<30	/<10		/<5	/<100	/<10			
E MILLER	10/21/81	Emma Miller Mine (shaft)	Groundwater	<1/<1		<20/<20	10/10	60/<30	<.2/<.2	<20/<20		<10/<10		<5/<5		10/10	43	4	2
DRUMLUMMON	01/08/82	Drumlummon Mine No.1 shaft (28 ft. below water surface)	Groundwater	<1/<1		<20/<20	10/10	13900/60	<.2/<.2	1850/1510		50/<10		<5/<5		20/20	81	25	8
GW-1	9/2/87	Sump connecting four wells near the upstream tailings pond	Groundwater						1.06										
Station #5	11/29/76	Seep into Silver Creek between upper and lower tailings ponds	Groundwater																
Station #5	01/12/77	Seep into Silver Creek between upper and lower tailings ponds	Groundwater	<1			<10	50			<50					10			
Station #5A	01/26/77	Seep into Silver Creek at lower tailings pond; western portion	Groundwater	<1			<10	80			<50					<10			
Station #5A	01/31/77	Seep into Silver Creek at lower tailings pond; western portion	Groundwater																
Station #5B	01/26/77	Seep into Silver Creek at lower tailings pond; eastern portion	Groundwater	<1			<10	140			<50					<10			
Station #5B	01/31/77	Seep into Silver Creek at lower tailings pond; eastern portion	Groundwater																

Note: WQB-7 standards for metals in groundwater are based upon the dissolved portion of the sample (after filtration through a 0.045 um membrane filter)

Table 2-11. Summary of Previous Silver Creek Drainage Groundwater and Adit Discharge Chemistry Results

Sample Station	Sample Date	Sample Location	Medium	K (mg/L)	Hardness (mg $CaCO_3$/L)	Total Suspended Solids (mg/L)	Total Dissolved Solids (mg/L)	Carbonate as CO_3 (mg/L)	Bicarbon-ate as HCO_3 (mg/L)	Total Alkalinity as $CaCO_3$ (mg/L)	Chloride (mg/L)	Sulfate (mg/L)	NO_3/NO_2-N (mg/L)	Total Cyanide (mg/L)	Source/Date
		WQB-7 Ground Water Human Health Standard	Groundwater										10000		
PIPINICH 25-200-GW-1	10/11/95	Pipinich Residence	Groundwater	1.0	145.0		195	0	167	137	1	19	0.62	0.005	Maxim, 1996
PIPINICH 25-200-GW-1	05/01/96	Pipinich Residence	Groundwater	2.0	158.0		197	0	173	142	2	19	0.98	0.005	Maxim, 1996
HULL 25-200-GW-2	10/11/95	Hull Residence	Groundwater	1.0	146.0		195	0	167	137	1	11	0.08	0.005	Maxim, 1996
HULL 25-200-GW-2	05/01/96	Hull Residence	Groundwater	2.0	140.0		176	0	167	137	2	10	0.13	0.005	Maxim, 1996
M-VILLE 25-200-GW-3	10/11/95	Marysville House	Groundwater	1.0	81.0		140	0	101	83	3	23	1.30	0.005	Maxim, 1996
HALL 25-200-GW-4	10/11/95	Hall Residence	Groundwater	1.0	7.0		175	0	104	85	7	24	3.48	0.005	Maxim, 1996
HALL 25-200-GW-4	05/01/96	Hall Residence	Groundwater	1.0	7.0		138	0	93	76	2	17	2.00	0.005	Maxim, 1996
25-200-PS-01	10/11/95	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge	1.0	119		160	0	129	106	2	19	1.22	0.005	Maxim, 1996
25-200-PS-01	02/08/96	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge	1.0	124		145	0	127	104	1	19	1.18	0.005	Maxim, 1996
25-200-PS-01	05/01/96	Bald Mountain (at culvert below ski area parking lot)	Adit Discharge	2.0	118		157	0	133	109	1	22		0.005	Maxim, 1996
25-200-PS-01A	10/11/95	Bald Mountain (at black pipe draining adit to storage tank)	Adit Discharge	1.0	114		142	0	123	101	1	15	0.78	0.014	Maxim, 1996
25-200-PS-02	10/11/95	Drumlummon adit	Adit Discharge	3.0	280		326	0	349	286	2	14	0.01	0.005	Maxim, 1996
25-200-PS-02	02/08/96	Drumlummon adit	Adit Discharge	5.0	287		306	0	339	278	2	12	0.19	0.005	Maxim, 1996
25-200-PS-02	05/01/96	Drumlummon adit	Adit Discharge	4.0	269		319	0	317	260	2	20	0.03	0.005	Maxim, 1996
Adit #1	07/17/96	Belmont Mine adit	Adit Discharge				171								Maxim, 1996
Adit #18	07/17/96	Collapsed mine adit near the ski base area	Adit Discharge				162								Maxim, 1996
Adit #2	07/17/96	Belmont Mine adit	Adit Discharge				142								Maxim, 1996
25-024-AD1	6/23-24/94	Drumlummon Mill; adit discharge on WR4	Adit Discharge		319		309				<5	24	<0.05		MDSL/AMRB, 1995
H8	08/27/81	Maskelyne Tunnel discharge at culvert	Adit Discharge	4	296	3	312	0	346	284	6	15			Goldsil Mining and Milling, Inc., 1984a
H8	12/07/81	Maskelyne Tunnel discharge at culvert	Adit Discharge	4	295	14	317	0	368	302	14	3			Goldsil Mining and Milling, Inc., 1984a
H10	10/21/81	Obie adit discharge	Adit Discharge	2	154	<1	172	0	169	139	23	2			Goldsil Mining and Milling, Inc., 1984a
TP #1	10/06/83	Tailings Pond Groundwater Monitoring System, Site #1	Groundwater											0.005	Hydrometrics, 1983
TP #2	10/06/83	Tailings Pond Groundwater Monitoring System, Site #2	Groundwater						288		2	26		<0.005	Hydrometrics, 1983
TP #4	10/06/83	Tailings Pond Groundwater Monitoring System, Site #4	Groundwater						272		2	26		<0.005	Hydrometrics, 1983
TP #5	10/06/83	Tailings Pond Groundwater Monitoring System, Site #5	Groundwater						269		2	25		<0.005	Hydrometrics, 1983
TP #1 SEEP	11/16/83	Seep near Tailings Pond Groundwater Monitoring System, Site #1	Groundwater											0.005	Hydrometrics, 1983
W-8	12/13/83	Robert O'Connell residence, Marysville	Groundwater	<1	128		142	0	133	109	1	24	0.14		Hydrometrics, 1983
W-22	12/13/83	Thomas residence, Marysville	Groundwater												Hydrometrics, 1983
W-35	12/13/83	Goldsil Mining and Milling, Inc., mill office supply well	Groundwater												Hydrometrics, 1983
E MILLER	10/21/81	Emma Miller Mine (shaft)	Groundwater	2	124	<1	142	0	135	110	22	1			Goldsil Mining and Milling, Inc., 1984a
DRUMLUMMON	01/08/82	Drumlummon Mine No.1 shaft (28 ft. below water surface)	Groundwater	5	302	13	314	0	372	305	2	8			Goldsil Mining and Milling, Inc., 1984a
GW-1	9/2/87	Sump connecting four wells near the upstream tailings pond	Groundwater											ND	MDHES, 1988
Station #5	11/29/76	Seep into Silver Creek between upper and lower tailings ponds	Groundwater											0.65	MT Dept. of Fish and Game, 1977
Station #5	01/12/77	Seep into Silver Creek between upper and lower tailings ponds	Groundwater											0.050	MT Dept. of Fish and Game, 1977
Station #5A	01/26/77	Seep into Silver Creek at lower tailings pond; western portion	Groundwater												MT Dept. of Fish and Game, 1977
Station #5A	01/31/77	Seep into Silver Creek at lower tailings pond; western portion	Groundwater											0.41	MT Dept. of Fish and Game, 1977
Station #5B	01/26/77	Seep into Silver Creek at lower tailings pond; eastern portion	Groundwater												MT Dept. of Fish and Game, 1977
Station #5B	01/31/77	Seep into Silver Creek at lower tailings pond; eastern portion	Groundwater											0.18	MT Dept. of Fish and Game, 1977

Note: WQB-7 standards for metals in groundwater are based upon the dissolved portion of the sample (after filtration through a 0.045 um membrane filter)

Maxim (DEQ-AMRB/Maxim, 1996) collected groundwater samples from four wells in the Marysville area. These wells represent water quality in both the shallow alluvial aquifer and the deeper bedrock aquifer. Water quality samples contained low concentrations of dissolved minerals and metals. Two of the wells contained elevated concentrations of nutrients. All of the samples collected meet federal drinking water Maximum Contaminant Level (MCL) and Secondary Maximum Contaminant Level (SMCL) standards.

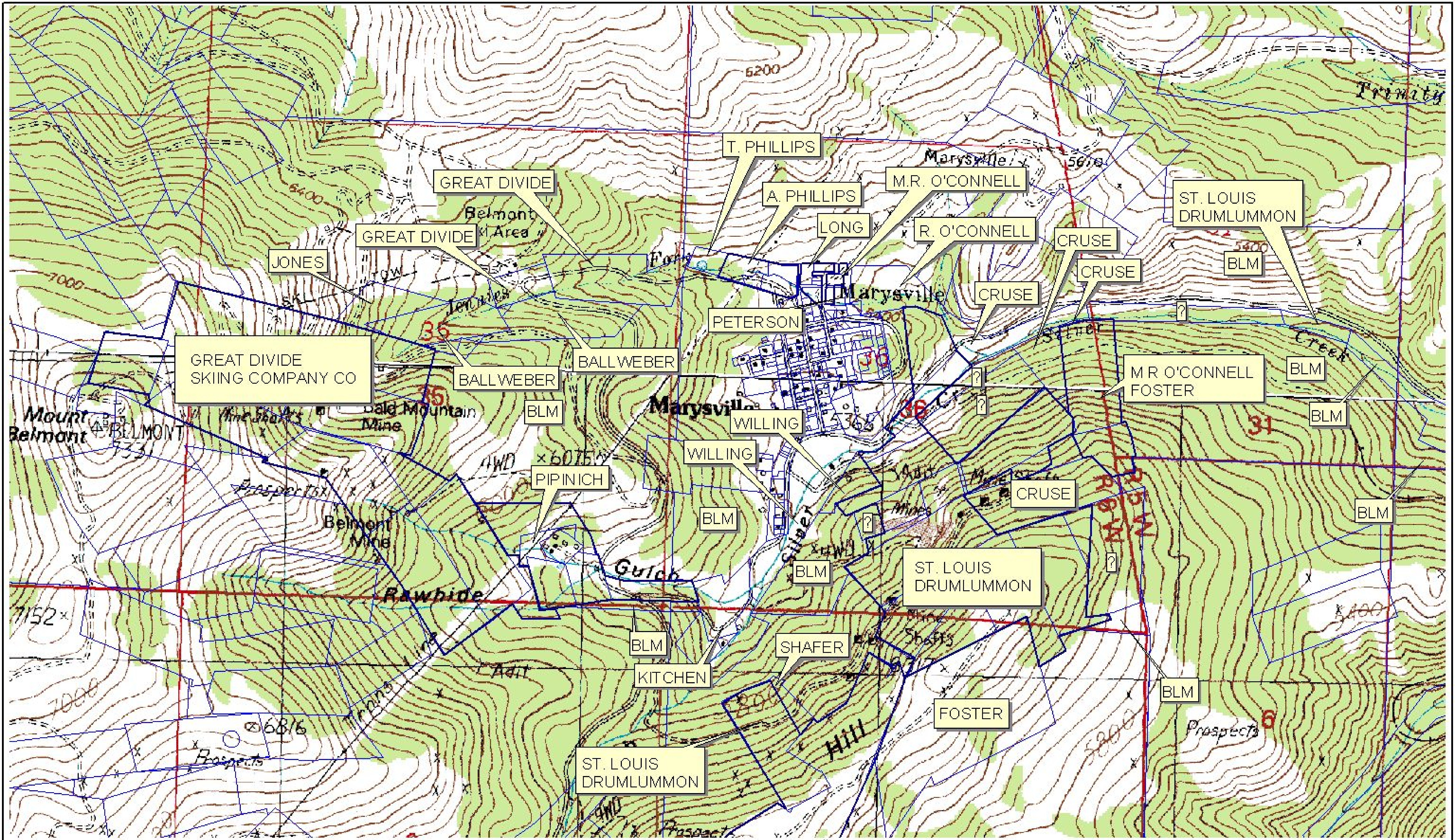
An operating permit submitted to MDSL (Goldsil Mining and Milling, Inc., 1984a and 1984b) included an inventory of wells and springs in the Marysville area and chemical analyses of 13 groundwater sampling sites. Groundwater, mine discharge water and spring water quality was reported as high quality, very hard, calcium-bicarbonate type. With the exception of total iron and total and dissolved manganese, metals concentrations were very low and often less than laboratory detection limits. All of the analyses reported would meet Federal Primary Drinking Water Standards and would meet Federal Secondary Standards with iron and manganese removal.

3.0 LAND OWNERSHIP SUMMARY

Land ownership in the areas adjacent to Silver Creek was compiled by MWCB and Olympus. MWCB send out letters and access agreements to potentially affected land owners prior to initiating field sampling. The majority of land owners responded and granted access to their property for characterization activities. Appendix A contains copies of the signed access agreements. Figures 3-1a through 3-e show land parcels and owners within the project boundaries. Table 3-1 provides a summary of land owners who signed and returned access agreements to the MWCB.

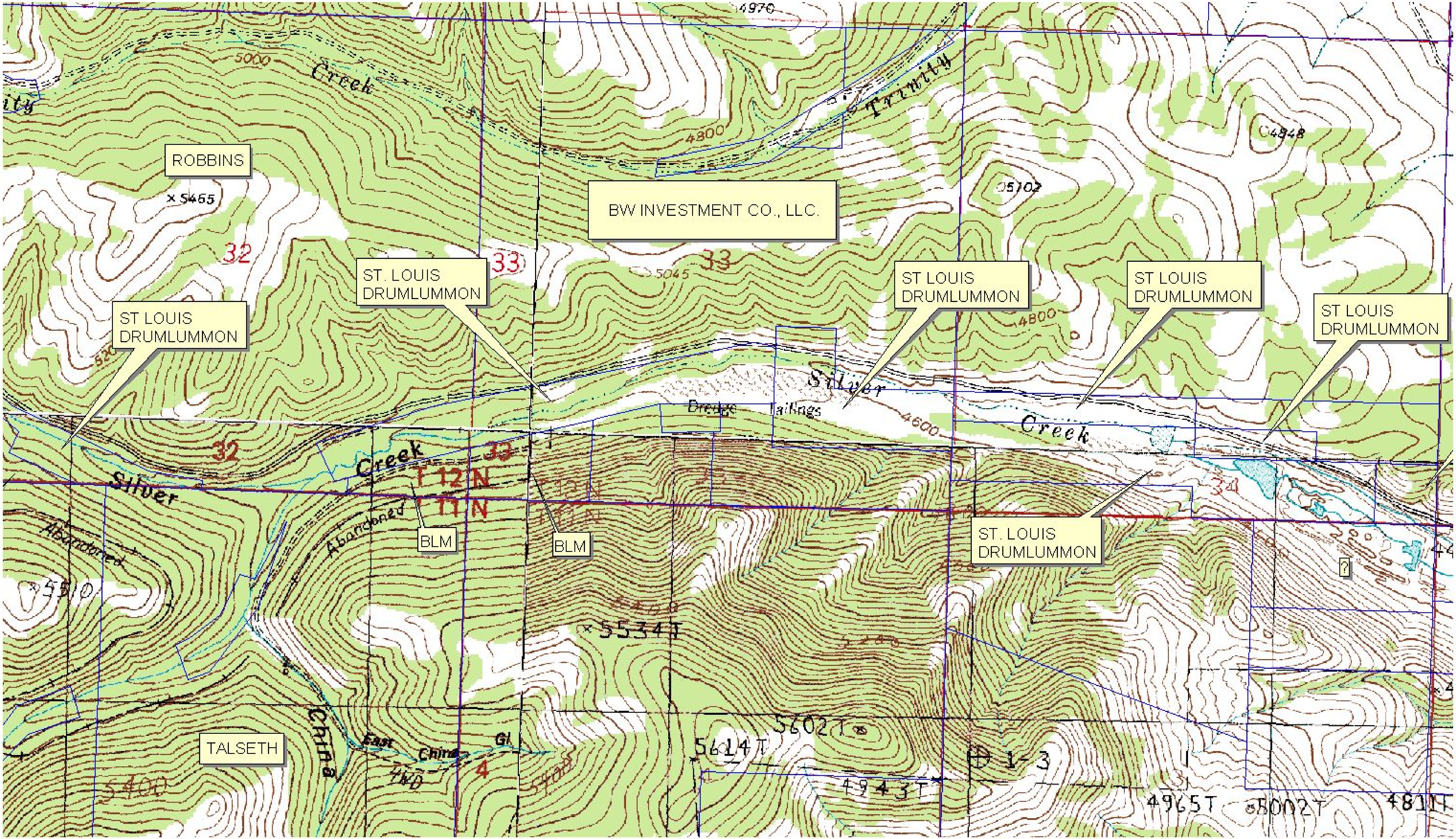
TABLE 3-1 SUMMARY OF LAND OWNER ACCESS AGREEMENTS

Owner Name	Owner Name
Anderson, Jerry	Marcucci, Michael and Andrea Sue
Anderson, H. Howard	Mares, Kenneth R.
Baker, Gary & Ann I.	O'Connell, Mary Ruth
Carson, David	O'Connell, Rick, ETAL
Connolly, Michael and Sarah	Phillips, Andre
Eskildsen, Max and Barbara	St. Louis Drumlummon Mines, Inc.
Farnam, Jill and Jay C. Lyndes	Settle Ranch Co.
Foster, Earle C. & Rhea L.	Shafer, Clem
Gebhardt, Judith A.	Shunick, Margaret A. Shunick-Duezabou
Great Divide Skiing Co.	Stevens, Jerry P. & Rachel M.
Gunnels, Martalee & Walter A.	Talley, Alton Ray & Mary J.
John, Theresa A.	Thomas Cruse Mining & Development
Jones, Alan / Valdean	Willing, William C.
Long, Cheri Lyn	



Olympus Technical Services, Inc.

Figure 3-1a. Silver Creek Drainage Project Land Ownership Map



Olympus Technical Services, Inc.

0 1000 2000 Feet

Figure 3-1b. Silver Creek Drainage Project Land Ownership Map

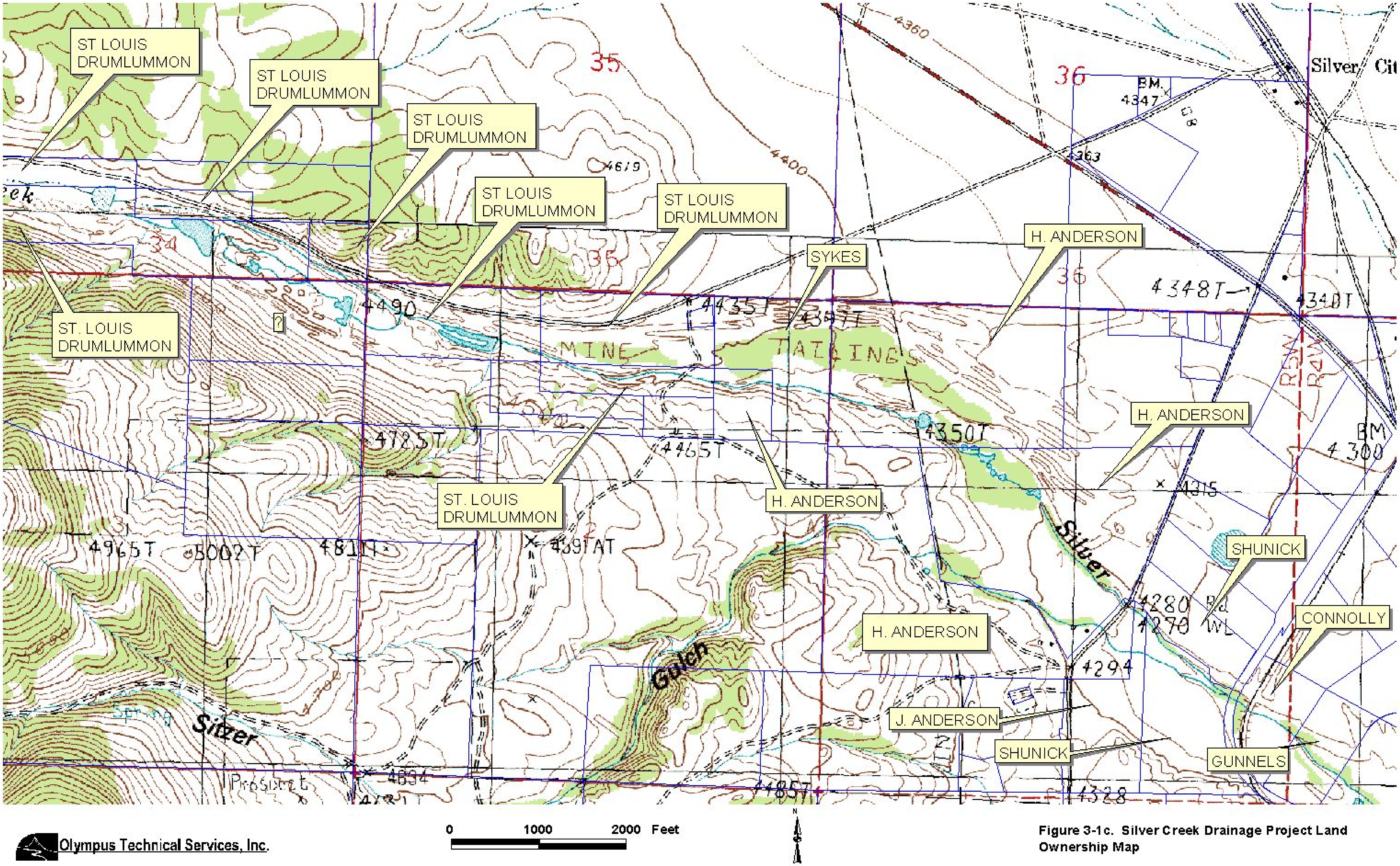
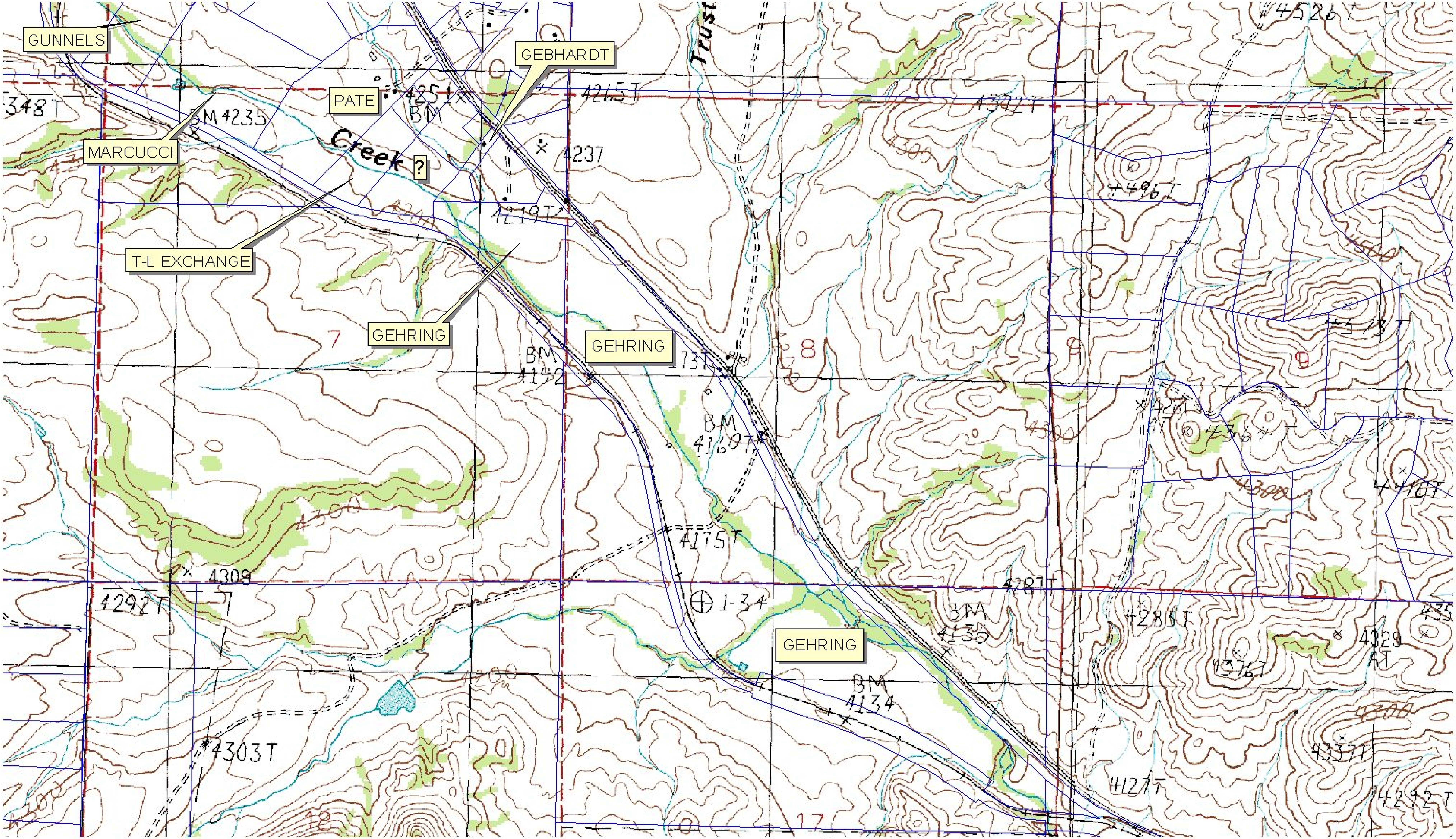


Figure 3-1c. Silver Creek Drainage Project Land Ownership Map



Olympus Technical Services, Inc.

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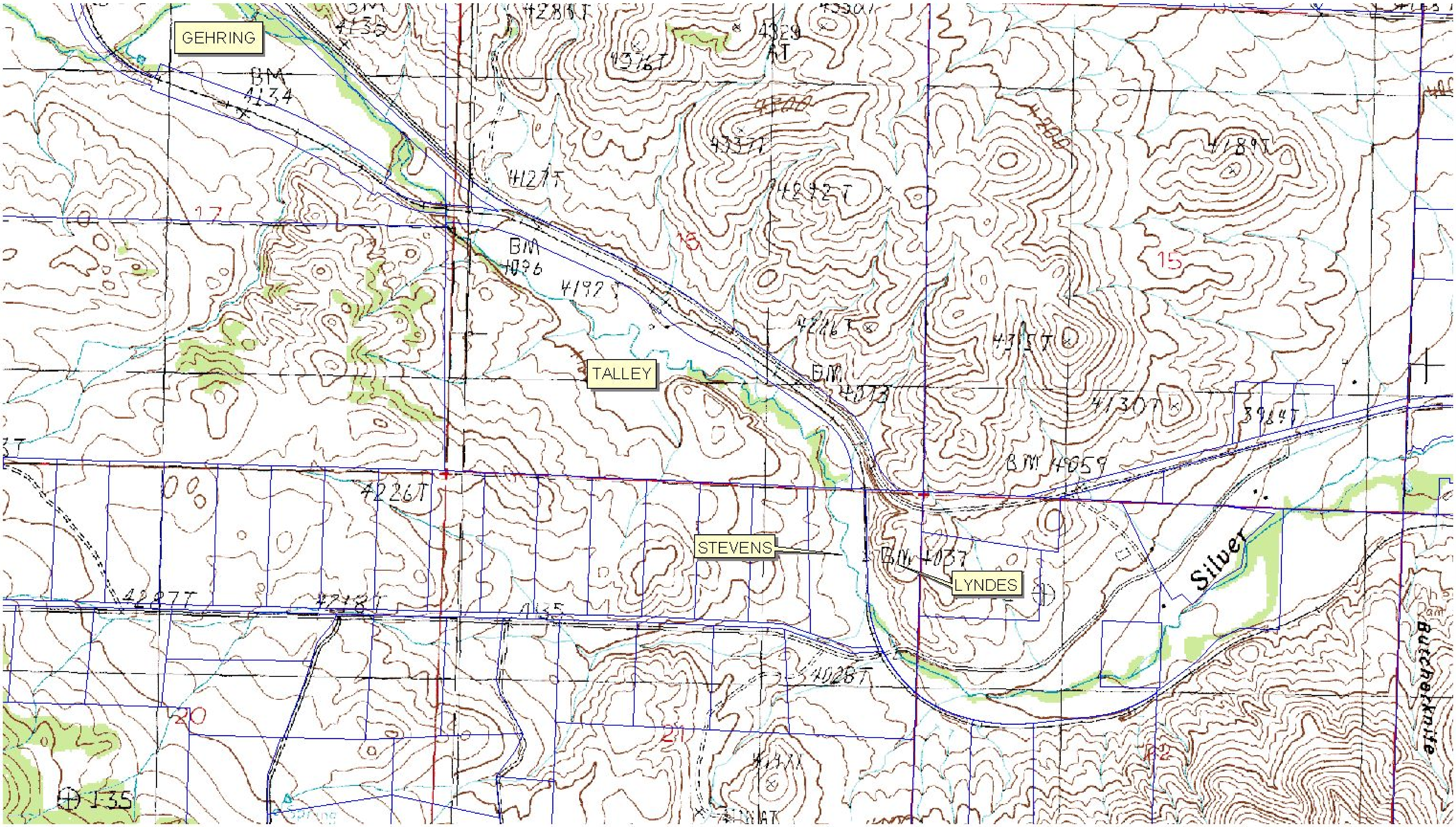
Figure 3-1d. Silver Creek Drainage Project Land Ownership Map



Olympus Technical Services, Inc.

Figure 3-1e. Silver Creek Drainage Project Land Ownership Map

4.0 FIELD ACTIVITIES

Field activities for the Phase I Reconnaissance Site Characterization took place during the period from June 11, 2002 through November 22, 2002. Because of the large area covered by the Phase I characterization, the project was divided into five primary units including: 1) stream corridor reconnaissance and stream sediment sampling, 2) the Upper Pond area, 3) the Middle Pond area, 4) the Lower Pond area and 5) the Placer Tailings area. The field activities for the Phase I Reconnaissance Site Characterization were confined to areas for which land owner access agreements had been obtained. Areas in the upper reaches of Silver Creek and Jennies Fork below the Belmont and Bald Mountain Mines, respectively, and a 1.9 mile long area on lower Silver Creek were not evaluated because access agreements were not executed. Access agreements were not executed for several other small land parcels, however, lack of access to these parcels did not significantly alter the characterization plans.

The principal techniques used for data acquisition in this site characterization were backhoe and shovel test pits, field mapping and soil sampling. Samples were collected using standard operating procedures that are contained in the Field Sampling Plan (DEQ-MWC/Olympus, 2002a) and were analyzed according to the Laboratory Analytical Plan (DEQ-MWC/Olympus, 2002d). Analytical data were evaluated for quality assurance according to the Quality Assurance Project Plan (DEQ-MWC/Olympus, 2002e).

4.1 FIELD SURVEY

Detailed topographic surveys of Drumlummon and Goldsil tailings piles and the Drumlummon waste rock piles (WR1, WR2, WR3 and WR4) were completed by Thompson & Associates of Butte, Montana. In addition, topographic surveys of the open pits in the Drumlummon Mine area were completed by Thompson & Associates. Features, such as adits, shafts and other features in the Drumlummon Mine area were surveyed for position, but not surveyed in topographic detail. The detailed survey maps of the Drumlummon and Goldsil areas were completed for use in the Phase II Detailed Site Characterization and the survey maps are presented in the Phase II Detailed Site Characterization report (DEQ-MWCB/Olympus, 2003).

4.2 SOURCE SAMPLING

Representative waste characterization samples were collected from the Silver Creek stream corridor and from the placer tailings piles within the Silver Creek Drainage Project area.

4.2.1 Stream Reconnaissance Characterization

The Silver Creek stream reconnaissance characterization work had the following objectives:

1. Mapping (using a combination of existing aerial photography, handheld GPS and Brunton compass and tape surveys) visible areas of mine waste and impacted soil in the area of the general stream corridor and tying the locations into established survey control points;

2. Identifying waste deposition in the stream bank and floodplain areas;

3. Reconnaissance assessment of the Shannon Mine site near headwaters of Ottawa Gulch;

4. Order of magnitude volume estimates of identified wastes;

5. Sampling of mine/mill waste and impacted sediments;

6. Lake and pond sediment sampling (i.e., Buck Lake and other significant pond areas);

7. Identifying other potential hazards (dilapidated structures, mine openings, etc.)

8. Evaluating site logistics (accessibility, existing haul roads, borrow materials, trees and other vegetation, weed issues, etc.) for possible future reclamation planning; and

9. Evaluating the extent of weed problems associated with the placer tailings piles.

Waste samples were collected by hand auger, shovel pits and backhoe pits. The following chemical and physical analytical suites were used to provide the data necessary to meet the above objectives:

1. Multi-element XRF screening analysis of field samples;

2. Metals (As, Cd, Cu, Hg, Pb and Zn) and total cyanide analysis of samples by laboratory analysis;

3. Analysis of additional stream sediment samples for Hg; and

4. Paste pH measurements.

Multi-element XRF analyses of samples were completed during field sampling activities to evaluate the chemical changes in the stream sediments and areas of mine/mill waste deposition. Samples were analyzed for mercury by the laboratory because XRF accuracy for this element is poor. The XRF was used to assess the concentrations of other analytes and to aid in screening the samples selected for total metal and total cyanide analyses. Stream sediment samples were analyzed at an average rate of 10 samples per stream mile for As, Cd, Cu, Hg, Pb, Zn, total cyanide and paste pH and an additional 5 samples per stream mile for Hg.

The primary purpose of the stream reconnaissance is to locate potential waste sources in the Silver Creek Drainage. The stream reconnaissance was completed primarily by traversing the Silver Creek corridor, mapping sample locations and potential waste deposition areas with a handheld GPS unit, collecting stream sediment samples at approximately 350 to 500 foot intervals (10 to 15 samples per stream mile), observing and documenting physical features and evaluation of stream sediment data. Data evaluation is presented in Section 6.1.

4.2.2 Placer Tailings Investigation

A large area of placer mine tailings are located in the area between the Goldsil millsite and Birdseye Road (Figures 1-7 and 1-8). The placer tailings investigation has the following objectives:

1. Mapping (using a combination of handheld GPS and Brunton compass and tape surveys) the aerial extent of placer tailings;

2. Characterizing the geology of placer tailings;

3. Chemical characterization via field screening and laboratory analyses of representative composite samples of the placer tailings piles;

4. Evaluating the borrow source viability of selected placer tailings piles via revegetation samples; and

5. Evaluating the extent of weed problems associated with the placer tailings piles.

Shovel pits were excavated in portions of the placer tailings to evaluate the geology and to provide representative grab samples for XRF analysis and composite samples for laboratory analyses. Sampling was biased to the finer grained fractions of the placer tailings. Samples were analyzed for mercury by the laboratory because XRF accuracy for this element is poor. The XRF was used to assess the concentrations of other analytes.

The placer tailing sampling was intended to provide representative coverage of the piles (i.e., top, slope face and toe areas). Grab samples were collected from shovel pits and concentrated on the finer fraction (less than 1 inch) material. XRF analyses were performed on grab samples collected from the placer tailing piles. Composite placer tailings samples were submitted for laboratory analyses of As, Cd, Cu, Hg, Pb, and Zn, total cyanide and paste pH.

4.3 BACKGROUND SOIL SAMPLING

Background soil chemistry was evaluated by collecting four representative grab samples from downstream of the Goldsil millsite area from suitable sites outside of the visibly impacted areas. Samples were collected from immediately below the A-horizon to a depth of 6-inches and sample sites were located in areas that are upgradient and/or outside of the mine/mill impacted areas. Background soil samples were analyzed for As, Cd, Cu, Hg, Pb, Zn and paste pH to establish concentration levels for comparison with results from waste source sampling. Two additional background soil samples were collected during the Phase II Detailed Site Characterization from areas upstream of the Goldsil millsite. The Phase II background soil sample were analyzed for Ag, As, Ba, Cd, Cr, Cu, Fe, Pb, Hg, Mn, Ni, Sb, Zn and paste pH. Data evaluation is presented in Section 5.0.

4.4 BORROW AREA(S) SAMPLING

The placer tailings located downstream of the Goldsil tailings and upstream of Birdseye Road have been identified as a potential source of cover soil for future reclamation of mine sites within the Silver Creek Drainage Project area. Sampling of selected placer tailings for borrow area suitability was completed as part of the Phase I Reconnaissance Site Characterization sampling. Soils from overburden piles in the placer mining area were sampled and analyzed for revegetation parameters including: N (as NO_3)-P-K, organic matter percent, pH, conductivity (salt hazard), saturation percent, soil texture class, and particle size analysis. Three composite samples were collected from backhoe and shovel test pits and analyzed for the above parameters. Data evaluation is presented in Section 6.3.2.

4.5 WATER SAMPLING

Surface water quality has previously been characterized in the Silver Creek drainage. Therefore, no surface water samples were collected during this project. Existing surface water data are summarized in Section 2.5.4.

No groundwater sampling was conducted as part of the Phase I Reconnaissance sampling. Groundwater has been characterized in the Goldsil millsite area as part of the Phase II Detailed Site Characterization. Previous groundwater data in the Silver Creek Drainage Project area are summarized in Section 2.5.5.

4.6 INVENTORY OF HAZARDOUS/SOLID WASTES AND PHYSICAL HAZARDS

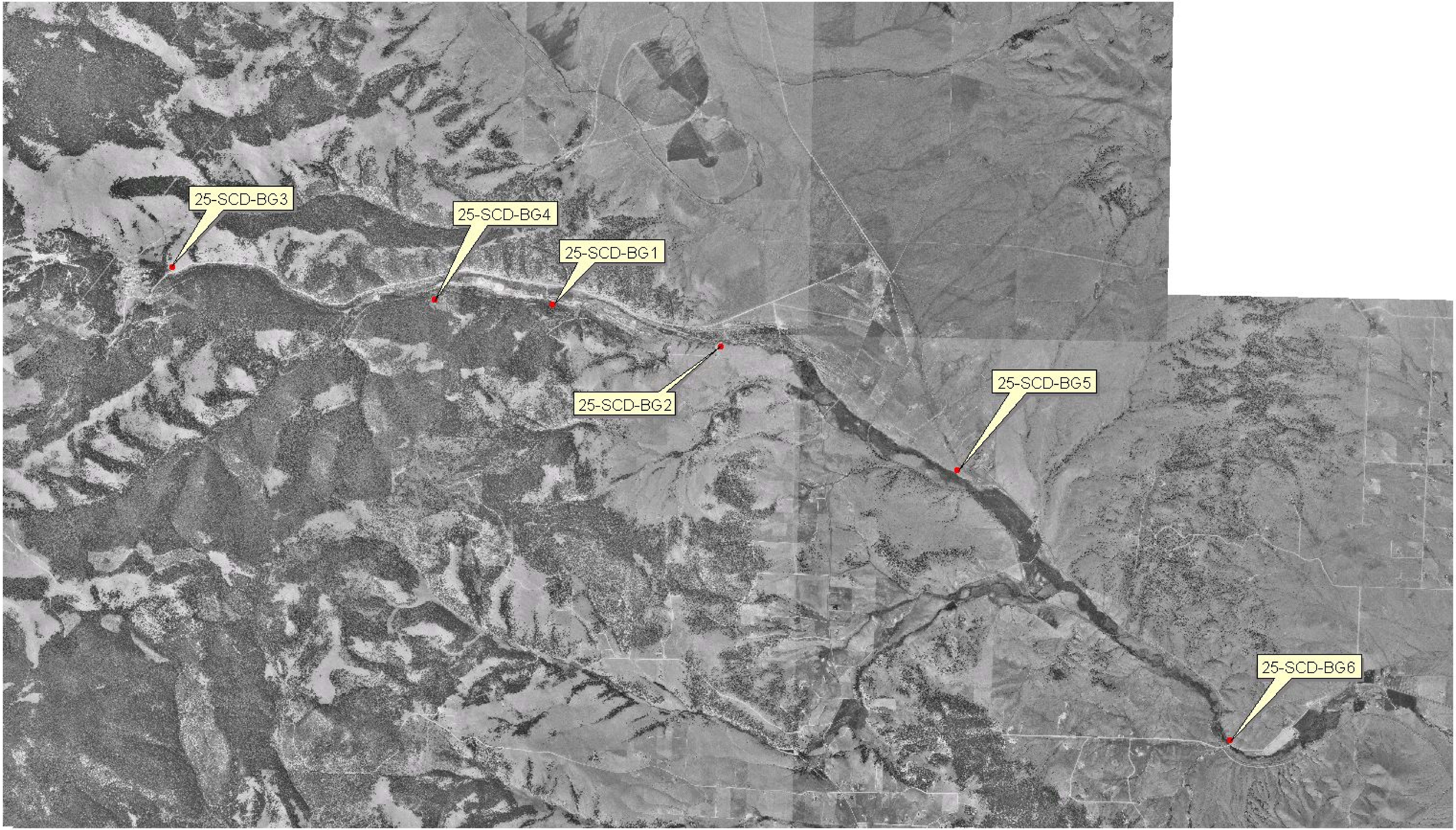
During the Phase I reconnaissance, an inventory of potential hazardous materials, solid wastes and physical hazards was compiled. The preliminary assessment of the Drumlummon Mine, Mill and tailings (MDSL/AMRB, 1993c) identified four hazardous openings (unfenced shafts), one hazardous structure (a loadout structure) and two highwalls (associated with two open, unfenced pits) at the Drumlummon Mine. One discharging adit was also identified. The preliminary assessment of the Goldsil Millsite (MDSL/AMRB, 1994) indicated that there are no hazardous openings, one hazardous structure (mill complex) and no unstable highwalls, pits or trenches. Olympus evaluated these potential hazards, as well as others discovered during the reconnaissance of the drainage. An assessment of physical hazards is presented in Section 7.0.

5.0 BACKGROUND SOIL CHARACTERIZATION

Four background soil samples were collected from below the Goldsil millsite area according to the Phase I FSP (MWCB/Olympus, 2002a). In addition, two background soil samples were collected from above the Goldsil millsite area according to the Phase II FSP (MWCB/Olympus, 2002b). The sample locations are shown on Figure 5-1. The sample locations were selected to provide representative coverage of the Silver Creek Drainage Project Area. The samples were collected from outside of known waste areas and areas of other disturbances.

Background soil samples were screened for a multi-element suite using a portable x-ray fluorescence (XRF) analyzer and the same samples were analyzed at Energy Laboratories, Inc. for paste pH, As, Cd, Cu, Hg, Pb and Zn. The two samples collected according to the Phase II FSP from above the Goldsil millsite were also analyzed for Ag, Ba, Cr, Fe, Mn, Ni and Sb. The laboratory analytical results are presented in Table 5-1. Laboratory analytical data and chain-of-custody are contained in Appendix B. XRF analytical results are contained in Appendix C.

Laboratory measured background soil pH ranges from 7.1 to 7.6 standard units (SU), with a mean of 7.4 SU. Cadmium, mercury and silver were below detection limits. Arsenic concentrations ranged from <5 to 46 mg/Kg with a mean of 25.2. Copper concentrations ranged from 16 to 105 mg/Kg with a mean of 34.2 mg/Kg. Lead concentrations ranged from 7 to 15 mg/Kg with a mean of 11.3 mg/Kg. Zinc concentrations ranged from 28 to 112 mg/Kg with a mean of 68.8 mg/Kg. Barium, chromium, iron, manganese and nickel had mean concentrations of 145 mg/Kg, 12 mg/Kg, 13,700 mg/Kg, 504 mg/Kg and 9 mg/Kg, respectively. Antimony concentrations were below detection limits (<5 mg/Kg) in one sample and 7 mg/Kg in the other sample.



Olympus Technical Services, Inc.

0 4000 8000 Feet

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● Background Soil Sample

Figure 5-1. Background Soil Sample Locations

Table 5-1. Laboratory Chemistry Results for Background Soils

Sample ID	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	Paste pH
25-SCD-BG1		46		<1		18		15	<1				70	7.1
25-SCD-BG2		46		<1		19		9	<1				28	7.6
25-SCD-BG3	<5	<5	164	<1	15	20	14000	7	<1	568	9	<5	57	7.3
25-SCD-BG4	<5	22	126	<1	9	16	13400	13	<1	440	9	7	56	7.3
25-SCD-BG5		6		<1		27		9	<1				112	7.6
25-SCD-BG6		6		<1		105		15	<1				90	7.3
Mean		25.2	145		12	34.2	13700	11.3		504	9		68.8	7.4
Maximum		46	164		15	105	14000	15		568	9		112	7.6
Minimum		<5				16		7					28	7.1

Pioneer Background Samples

Sample ID	Ag (mg/Kg)	As (mg/Kg)	Ba (mg/Kg)	Cd (mg/Kg)	Cr (mg/Kg)	Cu (mg/Kg)	Fe (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Mn (mg/Kg)	Ni (mg/Kg)	Sb (mg/Kg)	Zn (mg/Kg)	Paste pH
Big Ox Mine		25	650	<0.4	10.7	32.6	14700	28	0.187	662	14	<3	75	
Drumlummon	<0.7	8.2	312	<0.6	15	12.1	14500	<8.56	<0.03	454	9.8	<6.9	58.1	
Empire Mine		38	239	<0.5	14.1	49.7	19500	80	0.122	1000	<15	<4	153	
Mean		23.7333	400.333		13.2667	31.4667	16233.3	54	0.1545	705.333	11.9		95.3667	
Maximim		38	650		15	49.7	19500	80	0.187	1000	14		153	

Background soil samples were collected by Pioneer as part of the Hazardous Materials Inventories for the Bald Mountain Mine, Belmont Mine, Drumlummon Mine and Millsite and Goldsil millsite. The background soil samples referenced in the Hazardous Materials Inventories for these sites were collected at the Big Ox, Drumlummon and Empire Mine sites. A summary of the laboratory chemistry results of these background soils is presented in Table 5-1. Pioneer's background soil data are generally in the same range as the background soil data from this project. Cadmium and mercury were below detection limits in both data sets. The mean arsenic and copper concentrations have less than 10 percent relative percent differences between the two data sets. Both lead and zinc are higher in Pioneer background soil samples, although the overall concentrations are relatively low.

6.0 RECONNAISSANCE SITE CHARACTERIZATION RESULTS

6.1 SILVER CREEK STREAM SEDIMENTS

Stream sediment samples were collected from Silver Creek and Jennies Fork at an average frequency of 10 to 15 samples per stream mile or approximately every 350 to 500 feet. Samples were only collected from areas where access agreements had been signed by the land owner. Access agreements were not available for Silver Creek above Marysville, on Jennies Fork above the Great Divide Ski Area and a reach of lower Silver Creek. A total of 128 stream sediment samples and six duplicates for a total of 134 were collected and analyzed by Energy Laboratories. Of these 134 samples, 92 were analyzed for arsenic, cadmium, copper, mercury, lead, zinc, total cyanide and paste pH, and the remaining 42 were analyzed for mercury only. Stream sediment sample locations are shown on Figures 6-1a through 6-1e. Laboratory chemistry results for stream sediments are presented in Table 6-1 and laboratory analytical reports are contained in Appendix B. XRF analytical results are presented in Appendix C

The stream sediment sample results showed poor correlation between XRF and laboratory analytical results. This is most likely because of variability within the sediment matrix, including particle size, organic matter content and moisture. Unlike tailings samples, which typically have consistent particles size composition because of the milling process, the sediment samples have particle sizes ranging from sand and gravel down to fine silt and clay. Besides the particle size variation, the sediment samples contained a wide variety of organic matter. The coarse-grained sediments generally contained little or no organic matter. In fine silt/clay samples, especially from beaver and other pond areas, organic matter comprised a significant portion of the sediment matrix. For these reasons and because of the poor correlation between the XRF and laboratory data, the XRF data were not considered in the sediment evaluation.

Natural geologic systems are generally not normally distributed, and almost always skewed positively or negatively. Figure 6-2 shows frequency distribution plots for arsenic, copper, lead, mercury and zinc in Silver Creek stream sediments. These data show that the frequency distributions for these analytes are all positively skewed (skewed to the right). In a positively skewed data set, the mean will be greater than the median. If there is a sufficiently large data set, it is accepted practice to use the median rather than the mean in evaluating geochemical data that are skewed since the mean can be inflated by large, possibly outlying data points. Based on this reasoning, the median will be used to quantify the central tendency of the stream sediment data, rather than the mean.

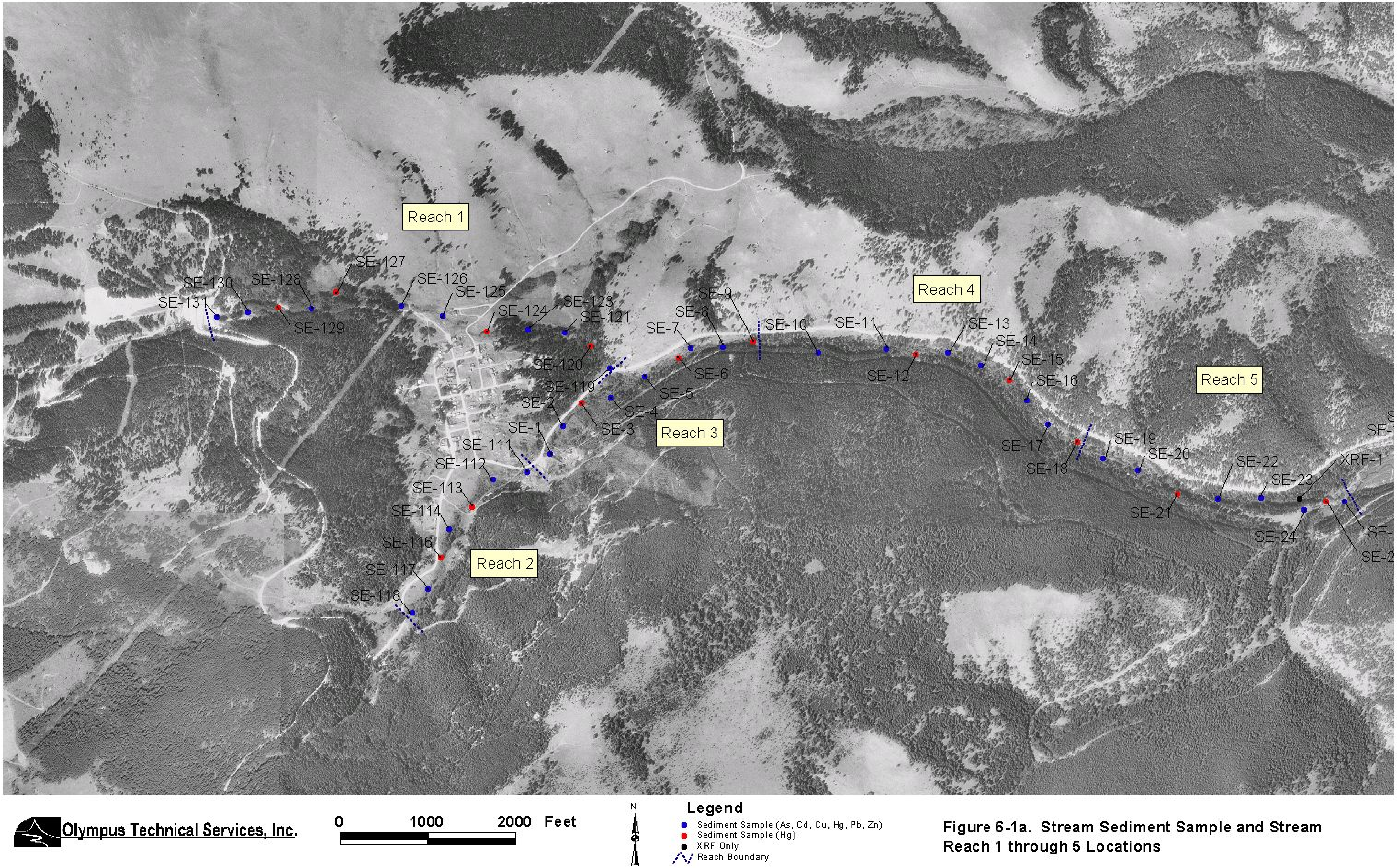
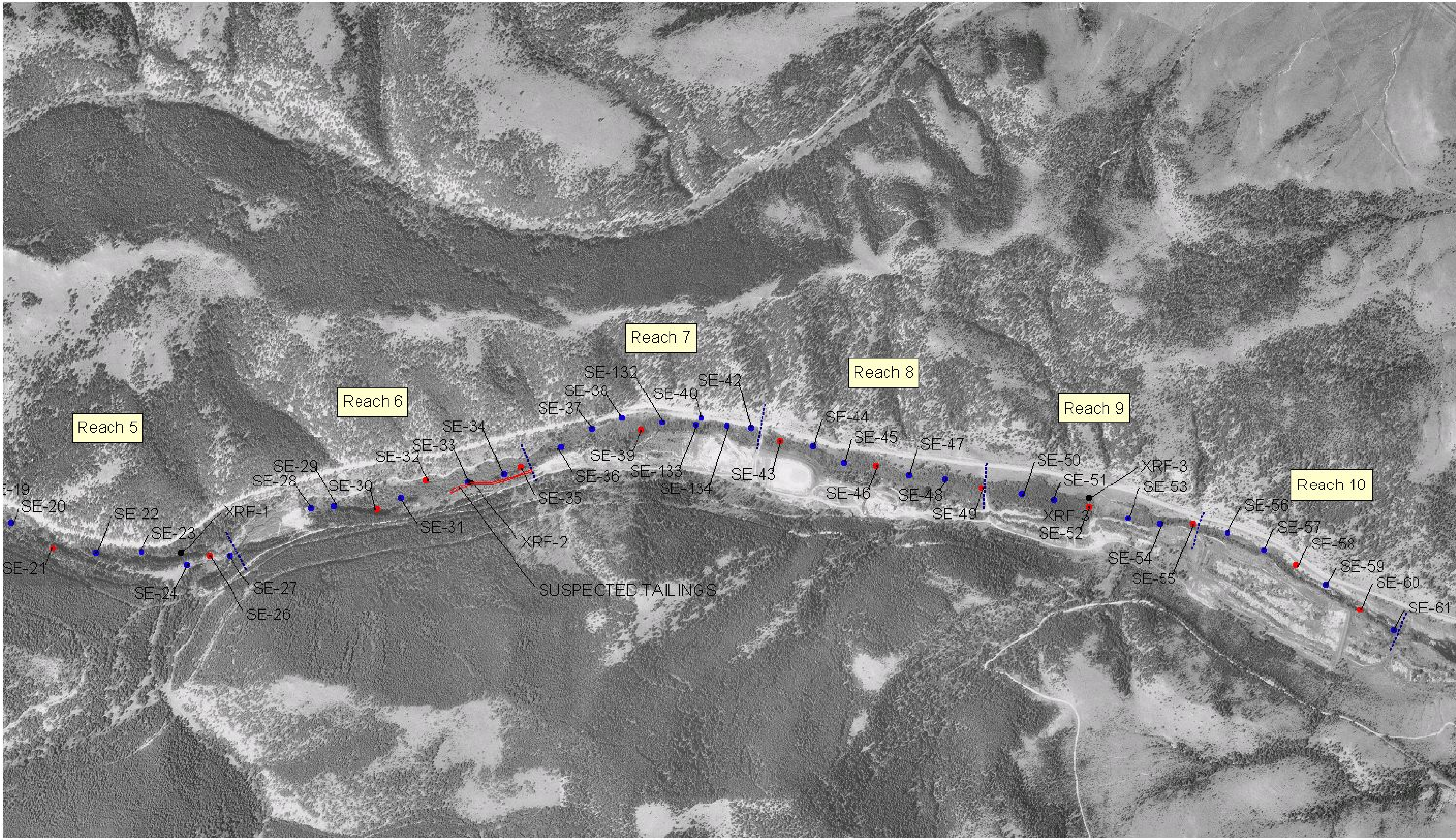


Figure 6-1a. Stream Sediment Sample and Stream Reach 1 through 5 Locations



Olympus Technical Services, Inc.

0 1000 2000 Feet

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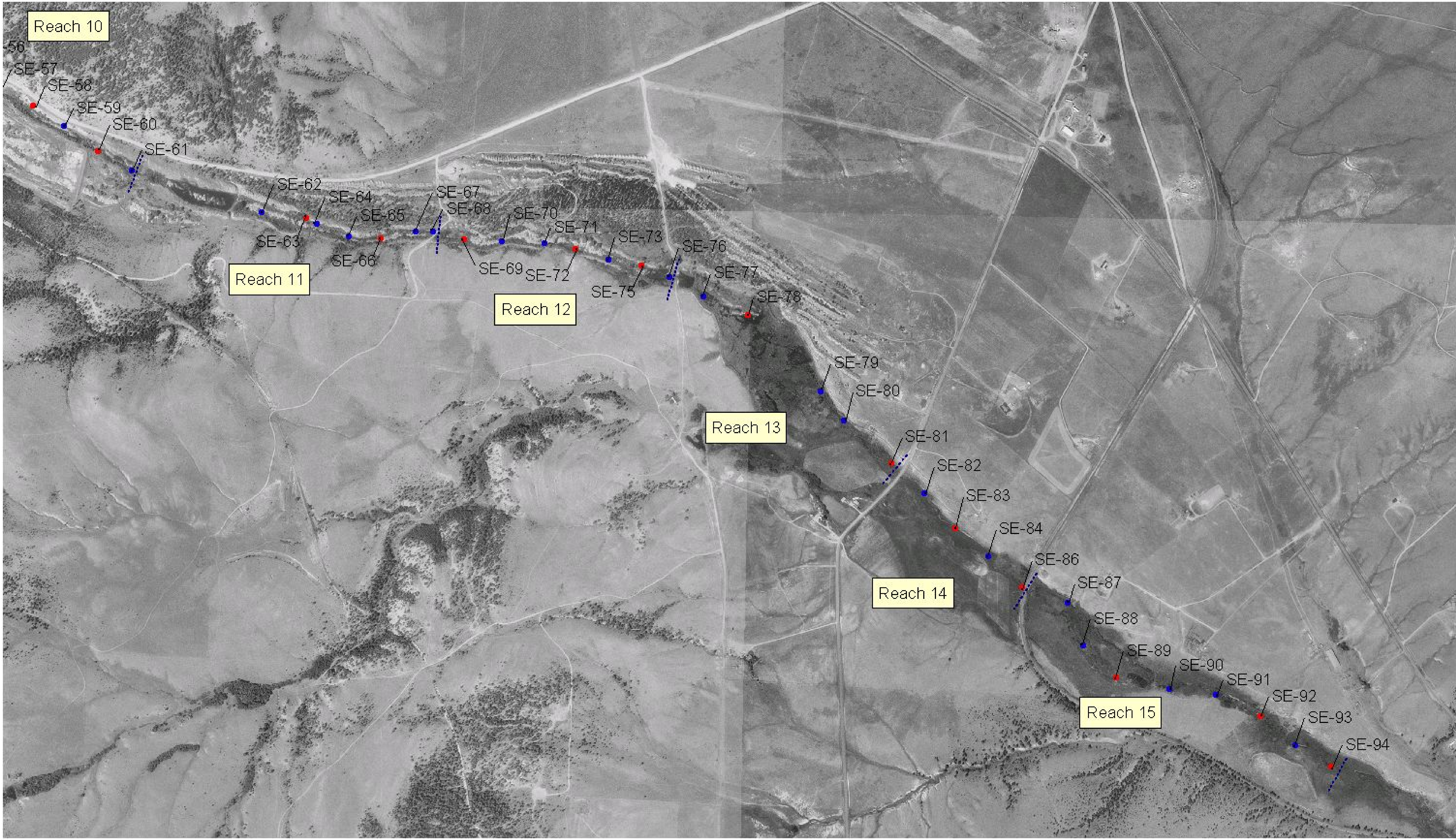
- XRF Only
- Sediment Sample (As, Cd, Cu, Hg, Pb, Zn)
- Sediment Sample (Hg)
- Reach Boundary

Figure 6-1b. Stream Sediment Sample and Stream Reach 6 Through 10 Locations



Olympus Technical Services, Inc.

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Reach Boundary
Sediment Sample (As, Cd, Cu, Hg, Pb, Zn)
Sediment Sample (Hg)

Figure 6-1c. Stream Sediment Sample and Stream Reach 11 Through 15 Locations

Olympus Technical Services, Inc.

0 1000 2000 Feet

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Reach Boundary
Sediment Sample (As, Cd, Cu, Hg, Pb, Zn)
Sediment Sample (Hg)

Figure 6-1d. Stream Sediment Sample and Stream Reach 16 and 17 Locations

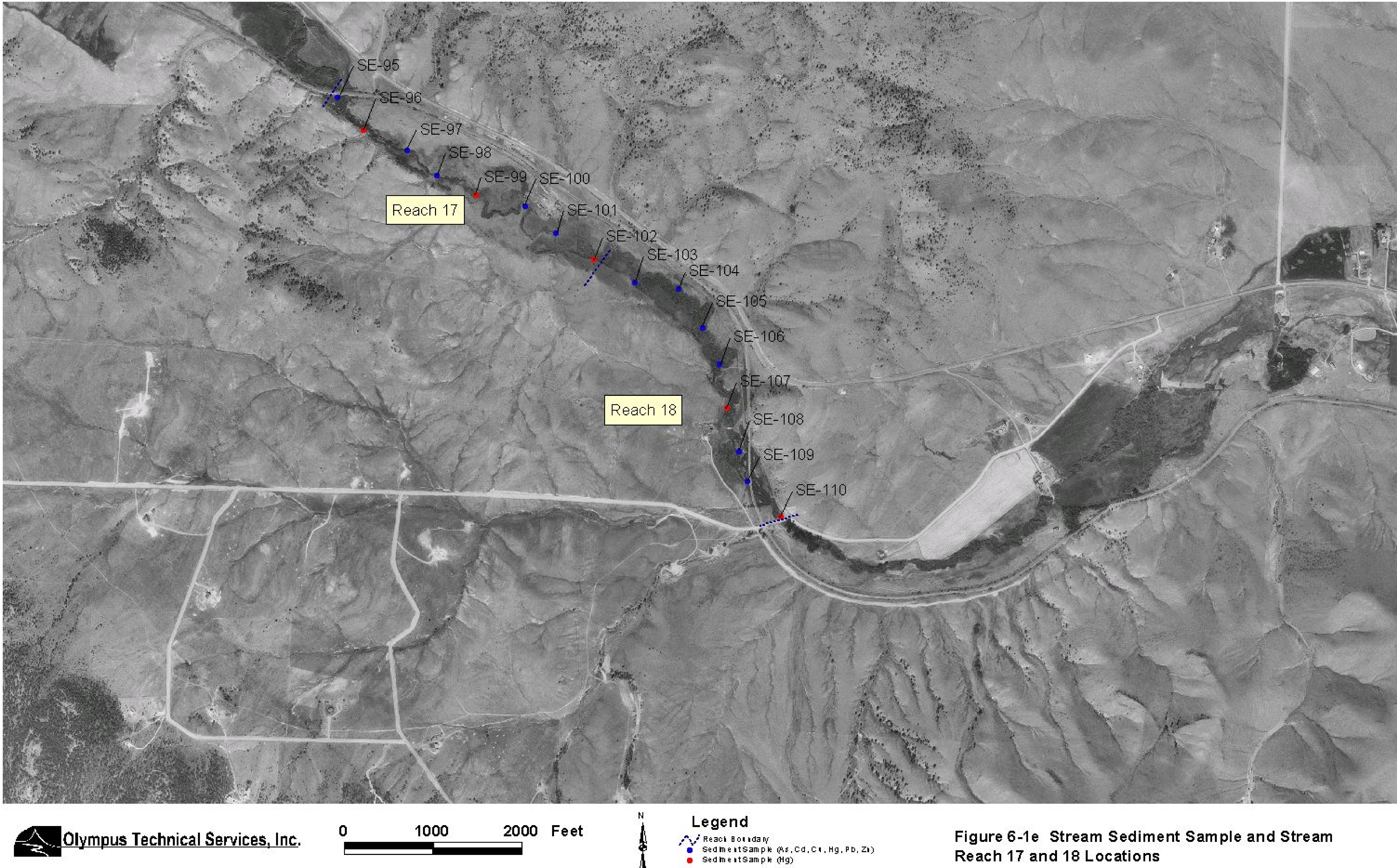


Figure 6-1e Stream Sediment Sample and Stream Reach 17 and 18 Locations

Table 6-1. Laboratory Chemistry Results for Stream Sediments

Sample ID	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)	Paste pH	Stream Mile	Reach No.	Comment
Jennies Fork											
25-SCD-SE-131	<5	<1	13	23	<1	52	<0.5	7.7	0.00	Reach 1	
25-SCD-SE-130	6	<1	18	24	<1	78	<0.5	7.7	0.07		
25-SCD-SE-129					<1				0.13		
25-SCD-SE-128	11	<1	37	75	<1	160	<0.5	7.6	0.21		
25-SCD-SE-127					<1				0.27		
25-SCD-SE-126	14	<1	52	93	<1	156	<0.5	7.5	0.41		
25-SCD-SE-125	8	<1	27	44	<1	89	<0.5	7.6	0.50		
25-SCD-SE-124					3				0.60		
25-SCD-SE-123	8	<1	24	37	<1	103	<0.5	7.6	0.69		
25-SCD-SE-122	9	<1	43	53	<1	125	<0.5	7.5			Dup of SE-121
25-SCD-SE-121	10	<1	28	42	<1	105	<0.5	7.6	0.77		
25-SCD-SE-120					<1				0.84		
25-SCD-SE-119	15	<1	29	50	<1	97	<0.5	7.5	0.90		
Silver Creek											
25-SCD-SE-118	<5	<1	6	11	<1	23	<0.5	7.8	0.00	Reach 2	
25-SCD-SE-117	15	<1	11	27	<1	43	<0.5	7.6	0.06		
25-SCD-SE-116					1				0.13		
25-SCD-SE-115	6	<1	14	29	<1	41	<0.5	7.4	0.20		Dup of SE-114
25-SCD-SE-114	9	<1	23	71	2	57	<0.5	7.3			
25-SCD-SE-113					14				0.27		
25-SCD-SE-112	13	<1	20	31	8	67	<0.5	7.2	0.34		
25-SCD-SE-111	6	<1	12	37	1	43	<0.5	7.4	0.42		
25-SCD-SE-1	15	<2	14	35	1	45	<0.2	7.6	0.48	Reach 3	
25-SCD-SE-2	13	<2	32	72	6	70	<0.2	7.5	0.54		
25-SCD-SE-3					<1				0.61		
25-SCD-SE-4	11	<1	26	65	5	68	<0.2	7.4	0.67		
25-SCD-SE-5	11	<1	37	76	4	112	<0.2	7.3	0.76		
25-SCD-SE-6					8				0.84		
25-SCD-SE-7	6	<1	42	40	6	54	<0.2	6.9	0.88		
25-SCD-SE-8	8	<1	27	45	2	89	<0.2	7.6	0.94		
25-SCD-SE-9					12				1.01		
25-SCD-SE-10	9	<1	37	61	5	119	<0.2	7.2	1.15	Reach 4	
25-SCD-SE-11	10	<1	35	46	2	93	<0.2	7.5	1.30		
25-SCD-SE-12					<1				1.36		
25-SCD-SE-13	5	<1	33	35	1	67	<0.5	7.1	1.43		
25-SCD-SE-14	7	<1	37	45	4	71	<0.5	6.8	1.51		
25-SCD-SE-15					3				1.58		
25-SCD-SE-16	7	<1	43	47	5	99	<0.5	7.4	1.63		

Table 6-1. Laboratory Chemistry Results for Stream Sediments

Sample ID	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)	Paste pH	Stream Mile	Reach No.	Comment
25-SCD-SE-17	6	<1	33	70	<1	76	<0.5	7.7	1.70		
25-SCD-SE-18					2				1.78		
25-SCD-SE-19	7	<1	23	34	2	61	<0.5	7.5	1.84	Reach 5	
25-SCD-SE-20	6	<1	29	36	2	77	<0.5	7.5	1.92		
25-SCD-SE-21					2				2.02		
25-SCD-SE-22	8	<1	29	30	2	67	<0.5	7.6	2.11		
25-SCD-SE-23	7	<1	30	42	4	80	<0.5	7.5	2.20		
25-SCD-SE-24	7	<1	30	37	3	80	<0.5	7.4	2.30		
25-SCD-SE-25	7	<1	34	39	3	86	<0.5	7.5			Dup of SE-24
25-SCD-SE-26					<1				2.35		
25-SCD-SE-27	5	<1	31	36	3	63	<0.5	7.6	2.39		
25-SCD-SE-28	7	<1	37	31	4	60	7.5	7.5	2.58	Reach 6	
25-SCD-SE-29	6	<1	35	32	4	63	<0.5	7.5	2.63		
25-SCD-SE-30					3				2.72		
25-SCD-SE-31	7	<1	53	41	5	84	<0.5	7.6	2.77		
25-SCD-SE-32					5				2.83		
25-SCD-SE-33	<5	<1	40	42	4	77	<0.5	7.5	2.92		
25-SCD-SE-34	<5	<1	43	42	6	71	<0.5	7.6	3.00		
25-SCD-SE-35					4				3.03		
25-SCD-SE-36	11	<1	27	30	3	66	7.6	7.6	3.12	Reach 7	
25-SCD-SE-37	10	<1	31	33	2	73	<0.5	7.6	3.20		
25-SCD-SE-38	<5	<1	34	36	4	69	0.8	7.7	3.26		
25-SCD-SE-39					5				3.31		
25-SCD-SE-132	13	2	107	81	11	148	<0.5	8	3.35		
25-SCD-SE-133	22	1	164	154	18	215	<0.5	7.9	3.42		
25-SCD-SE-40	6	<1	53	51	10	103	<0.5	7.6	3.44		
25-SCD-SE-41	6	<1	50	48	9	93	1	7.6			Dup of SE-40
25-SCD-SE-134	8	<1	64	59	10	98	<0.5	7.6	3.50		
25-SCD-SE-42	12	<1	120	86	30	107	<0.5	7.6	3.55		
25-SCD-SE-43					16				3.61	Reach 8	
25-SCD-SE-44	10	<1	48	34	10	70	<0.5	7.3	3.68		
25-SCD-SE-45	9	<1	36	31	8	68	<0.5	7.4	3.75		
25-SCD-SE-46					5				3.82		
25-SCD-SE-47	24	<1	54	49	4	112	<0.5	7.7	3.89		
25-SCD-SE-48	36	<1	114	47	4	155	<0.5	7.8	3.96		
25-SCD-SE-49					2				4.04		
25-SCD-SE-50	14	<1	30	23	7	47	<0.5	7.5	4.12	Reach 9	
25-SCD-SE-51	53	<1	58	39	9	85	<0.5	7.4	4.19		
25-SCD-SE-52					10				4.26		

Table 6-1. Laboratory Chemistry Results for Stream Sediments

Sample ID	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)	Paste pH	Stream Mile	Reach No.	Comment
25-SCD-SE-53	29	<1	37	29	6	64	<0.5	7.4	4.35		
25-SCD-SE-54	26	<1	40	32	4	71	<0.5	7.8	4.41		
25-SCD-SE-55					4				4.48		
25-SCD-SE-56	35	<1	31	23	6	52	<0.5	7.5	4.55	Reach 10	
25-SCD-SE-57	12	<1	29	21	4	55	<0.5	7.4	4.63		
25-SCD-SE-58					6				4.71		
25-SCD-SE-59	13	<1	25	18	6	51	<0.5	7.5	4.78		
25-SCD-SE-60					7				4.87		
25-SCD-SE-61	14	<1	22	25	5	58	<0.5	7.9	4.95		
25-SCD-SE-62	14	<1	51	29	14	83	<0.5	7.5	5.22	Reach 11	
25-SCD-SE-63					3				5.32		
25-SCD-SE-64	6	<1	21	10	5	32	<0.5	7.6	5.34		
25-SCD-SE-65	<5	<1	23	10	6	30	<0.5	7.4	5.41		
25-SCD-SE-66					5				5.48		
25-SCD-SE-67	10	<1	40	17	11	56	<0.5	7.5	5.55		
25-SCD-SE-68	6	<1	24	12	4	39	<0.5	7.5	5.58		
25-SCD-SE-69					5				5.65	Reach 12	
25-SCD-SE-70	5	<1	46	27	9	54	<0.5	7.8	5.73		
25-SCD-SE-71	<5	<1	63	36	12	69	<0.5	7.6	5.81		
25-SCD-SE-72					1				5.88		
25-SCD-SE-73	9	<1	29	17	4	46	<0.5	7.3	5.95		
25-SCD-SE-74	8	<1	28	16	4	45	<0.5	7.4			Dup of SE-73
25-SCD-SE-75					3				6.02		
25-SCD-SE-76	7	<1	18	10	2	33	<0.5	7.4	6.08		
25-SCD-SE-77	10	<1	23	16	2	42	<0.5	7.3	6.16	Reach 13	
25-SCD-SE-78					1				6.26		
25-SCD-SE-79	11	<1	71	62	6	99	<0.5	7.6	6.47		
25-SCD-SE-80	15	<1	67	48	23	86	<0.5	7.5	6.55		
25-SCD-SE-81					9				6.68		
25-SCD-SE-82	21	<1	112	90	19	144	<0.5	7.4	6.77	Reach 14	
25-SCD-SE-83					<1				6.86		
25-SCD-SE-84	9	<1	63	41	9	75	<0.5	7.3	6.95		
25-SCD-SE-85	8	<1	85	57	10	84	<0.5	7.3			Dup of SE-84
25-SCD-SE-86					7				7.05		
25-SCD-SE-87	9	1	183	123	40	149	<0.5	7.6	7.14	Reach 15	
25-SCD-SE-88	29	<1	42	35	5	38	<0.5	7.6	7.24		
25-SCD-SE-89					12				7.33		
25-SCD-SE-90	15	<1	32	24	4	51	<0.5	7.6	7.44		
25-SCD-SE-91	11	<1	30	22	1	51	<0.5	7.6	7.54		

Table 6-1. Laboratory Chemistry Results for Stream Sediments

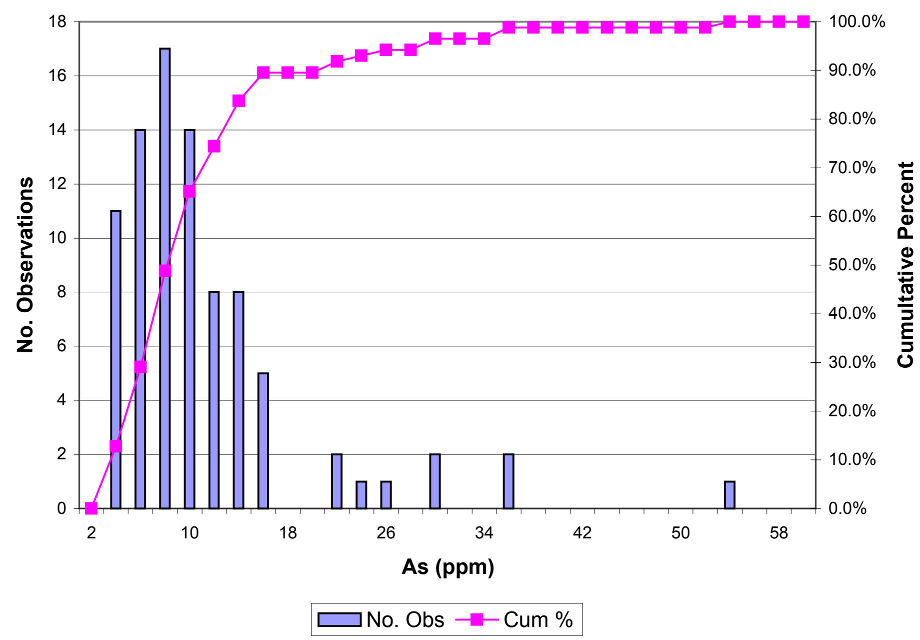
Sample ID	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)	Paste pH	Stream Mile	Reach No.	Comment
25-SCD-SE-92					2				7.64		
25-SCD-SE-93	6	<1	17	12	6	39	<0.5	7.3	7.73		
25-SCD-SE-94					3				7.82		
				No Access Agreement						Reach 16	
25-SCD-SE-95	7	<1	54	36	10	73	<0.5	7.5	9.77	Reach 17	
25-SCD-SE-96					7				9.85		
25-SCD-SE-97	10	<1	25	24	3	54	<0.5	7.6	9.96		
25-SCD-SE-98	<5	<1	43	29	8	55	<0.5	7.4	10.04		
25-SCD-SE-99					9				10.13		
25-SCD-SE-100	<5	<1	40	27	7	60	1.7	7.5	10.24		
25-SCD-SE-101	5	<1	47	30	10	66	<0.5	7.4	10.33		
25-SCD-SE-102					9				10.43		
25-SCD-SE-103	10	<1	79	50	18	80	<0.5	7.4	10.53	Reach 18	
25-SCD-SE-104	7	<1	72	43	12	78	<0.5	7.4	10.62		
25-SCD-SE-105	8	<1	58	36	12	79	<0.5	7.2	10.72		
25-SCD-SE-106	7	<1	46	26	7	59	<0.5	7.3	10.80		
25-SCD-SE-107					9				10.89		
25-SCD-SE-108	<5	<1	47	30	11	59	<0.5	7.5	10.99		
25-SCD-SE-109	<5	<1	56	35	10	75	<0.5	7.5	11.06		
25-SCD-SE-110					11				11.16		

Summary Statistics

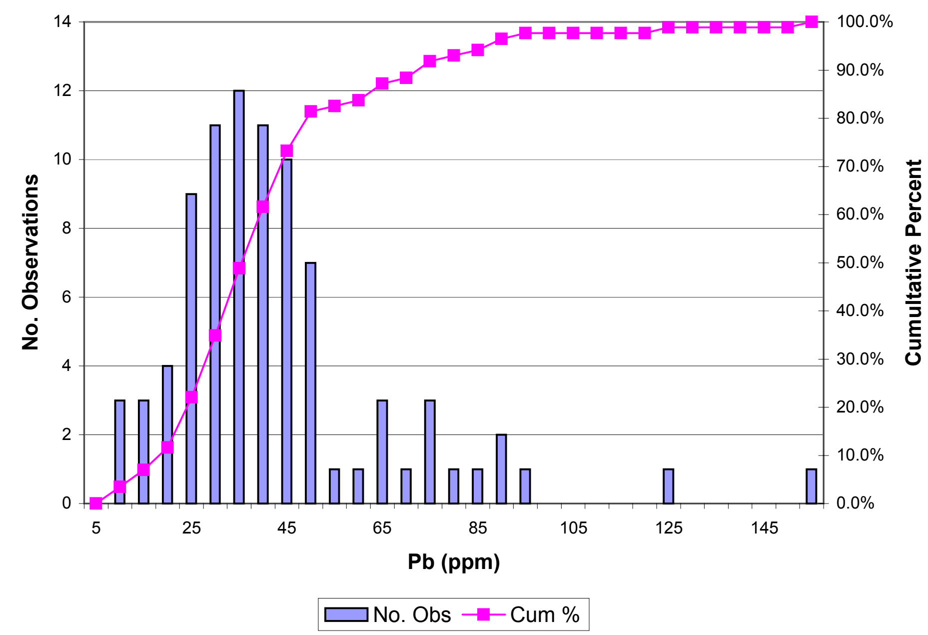
	As* (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg* (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)	Paste pH
Mean	10.42		43.22	40.82	5.87	76.24	3.72	7.50
Median	8		35.5	36	4	70	1.7	7.5
Maximum	53	2	183	154	40	215	7.6	8.0
Minimum	<5	<1	6	10	<1	23	<0.5	6.8
No. Samples	92		92	92	134	92	5	92

*Values below detection limit taken as 1/2 detection limit

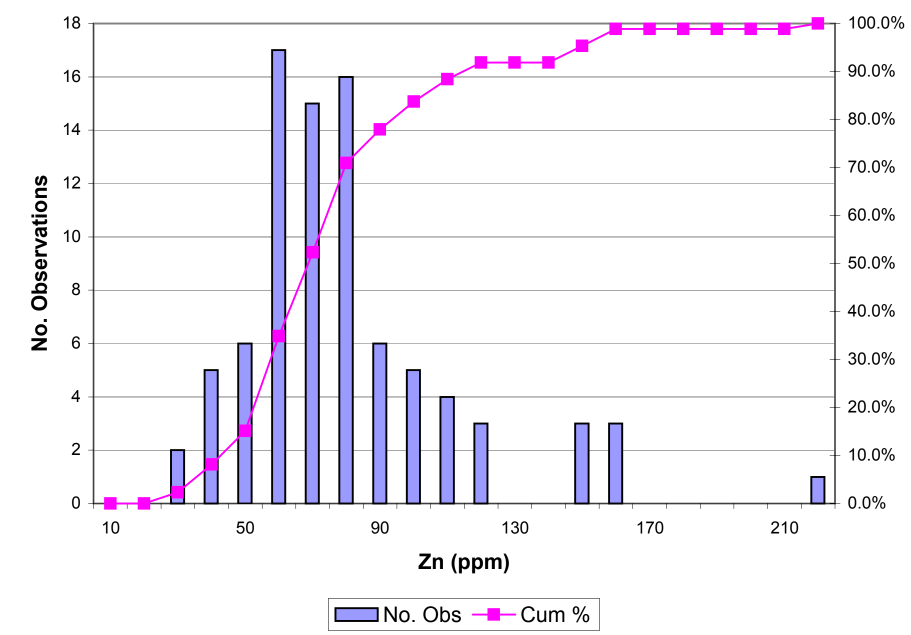
Arsenic Frequency Distribution in Sediment



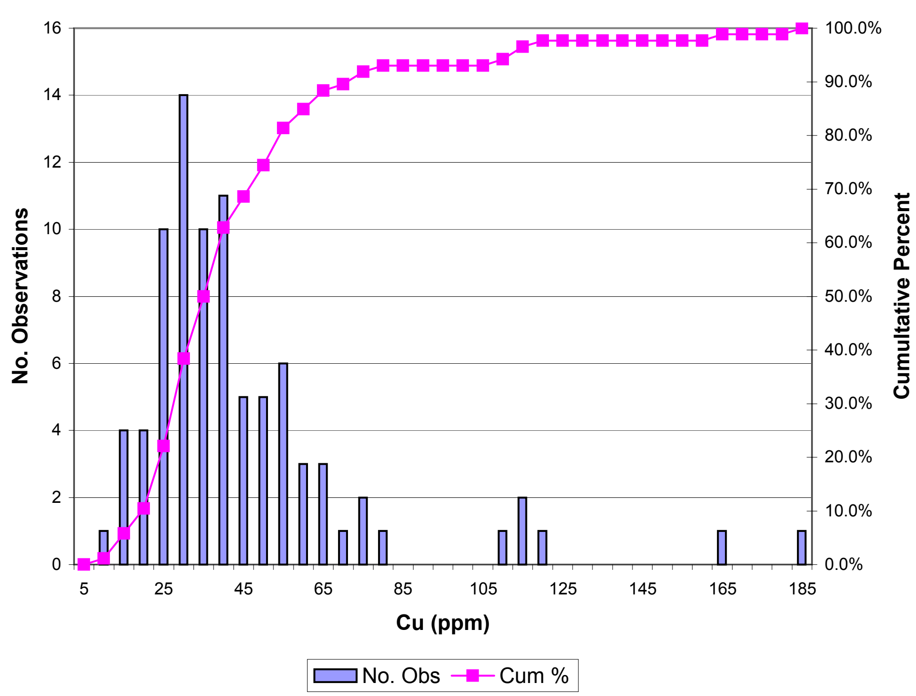
Lead Frequency Distribution in Sediment



Zinc Frequency Distribution in Sediment



Copper Frequency Distribution in Sediment



Mercury Frequency Distribution in Sediment

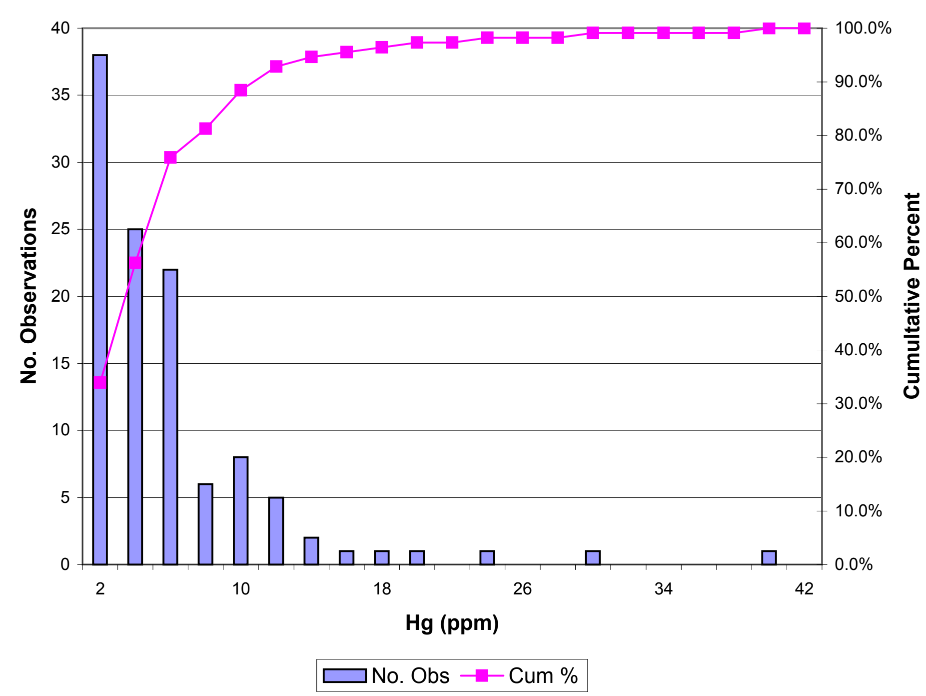


Figure 6-2. Frequency Distribution Plots of Laboratory Chemistry Results for Stream Sediments

Cadmium was present above the laboratory detection limit of 1 mg/Kg in only three of the 92 stream sediment samples. Two of the samples had cadmium concentrations equal to the detection limit (1 mg/Kg) and the maximum cadmium concentration was 2 mg/Kg. The median arsenic concentration in stream sediments is 8 mg/Kg, with a maximum concentration of 53 mg/Kg. The median copper concentration in stream sediments is 35.5 mg/Kg, with a maximum concentration of 183 mg/Kg. The median lead concentration in stream sediments is 36 mg/Kg, with a maximum concentration of 154 mg/Kg. The median mercury concentration in stream sediments is 4 mg/Kg, with a maximum concentration of 40 mg/Kg. The median zinc concentration in stream sediments is 70 mg/Kg, with a maximum concentration of 215 mg/Kg. Total cyanide was present above the detection limit of 0.5 mg/Kg in only five of the 92 stream sediment samples. The detectable values of total cyanide had a mean and maximum concentrations of 3.7 mg/Kg and 7.6 mg/Kg, respectively. Paste pH values ranged from 6.8 to 8.0 SU, with both a mean and median of 7.5 SU.

The following are the laboratory median concentrations for each element analyzed in the stream sediments relative to the mean background concentration: As (0.4 times background or 0.4x), Cu (1.04x), Pb (3.2x), Hg (>8x) and Zn (1.02x). This comparison of stream sediment metal/metalloid concentrations to background indicates that mean arsenic concentrations are significantly less than background, while copper and zinc concentrations are approximately equal to background. Lead and mercury concentrations are elevated relative to background. It should be noted that the background soil concentration of mercury was taken as 0.5 mg/Kg (half of the detection limit) since mercury was not present above the detection limit in of 1 mg/Kg in the background samples. However, background soil samples collected by Pioneer had mercury concentrations ranging from less than 0.03 mg/Kg to 0.187 mg/Kg. Based on these data, the median mercury concentration could be greater than 100 times the times the mean background concentration.

To evaluate the metal/metalloid concentrations in stream sediments in more detail, Silver Creek and Jennies Fork were divided into 18 separate stream reaches. These reaches were selected based on a number of factors including: reach length, the number of samples per reach, waste sources within a reach and physical features such as road crossings. The reaches are shown on Figure 6-1a through 6-1e.

Figures 6-3a through 6-3e show the concentration of arsenic, copper, mercury, lead and zinc along Silver Creek, and Figure 6-3f shows these concentrations along Jennies Fork. Figure 6-3a shows that peak arsenic concentrations occur in Reaches 8, 9, and 10, with smaller peak concentrations in Reaches 7, 14 and 15. Figure 6-3b shows that peak copper concentrations occur in Reaches 7 and 8, Reaches 14 and 15, and a smaller peak in Reach 18. Figure 6-3c shows that peak lead concentrations occur in Reach 7 and in Reaches 14 and 15. Figure 6-3d shows that peak mercury concentrations occur in Reaches 7 and 8, Reaches 13, 14 and 15, and a smaller peak in Reach 18. Figure 6-3e shows that peak zinc concentrations occur in Reaches 7 and 8, and in Reaches 14 and 15. Figure 6-3f shows that metal concentrations are relatively constant along Reach 1. Comparison of Figures 6-3a through 6-3e indicate consistent patterns among reaches, with peak concentrations consistently occurring in Reaches 7, 8, 14 and 15. Reaches 7 and 8 are adjacent to the Goldsil tailings and millsite. Reaches 14 and 15 are downstream from Birdseye Road.

To further evaluate the stream reaches, statistics, including the maximum, mean and median metal/metalloid concentrations, were calculated for each reach and are presented in Table 6-2. These results are plotted by reach on Figures 6-4a through 6-4e for arsenic, copper, mercury, lead and zinc, respectively.

Figure 6-3a. Arsenic in Silver Creek Stream Sediments

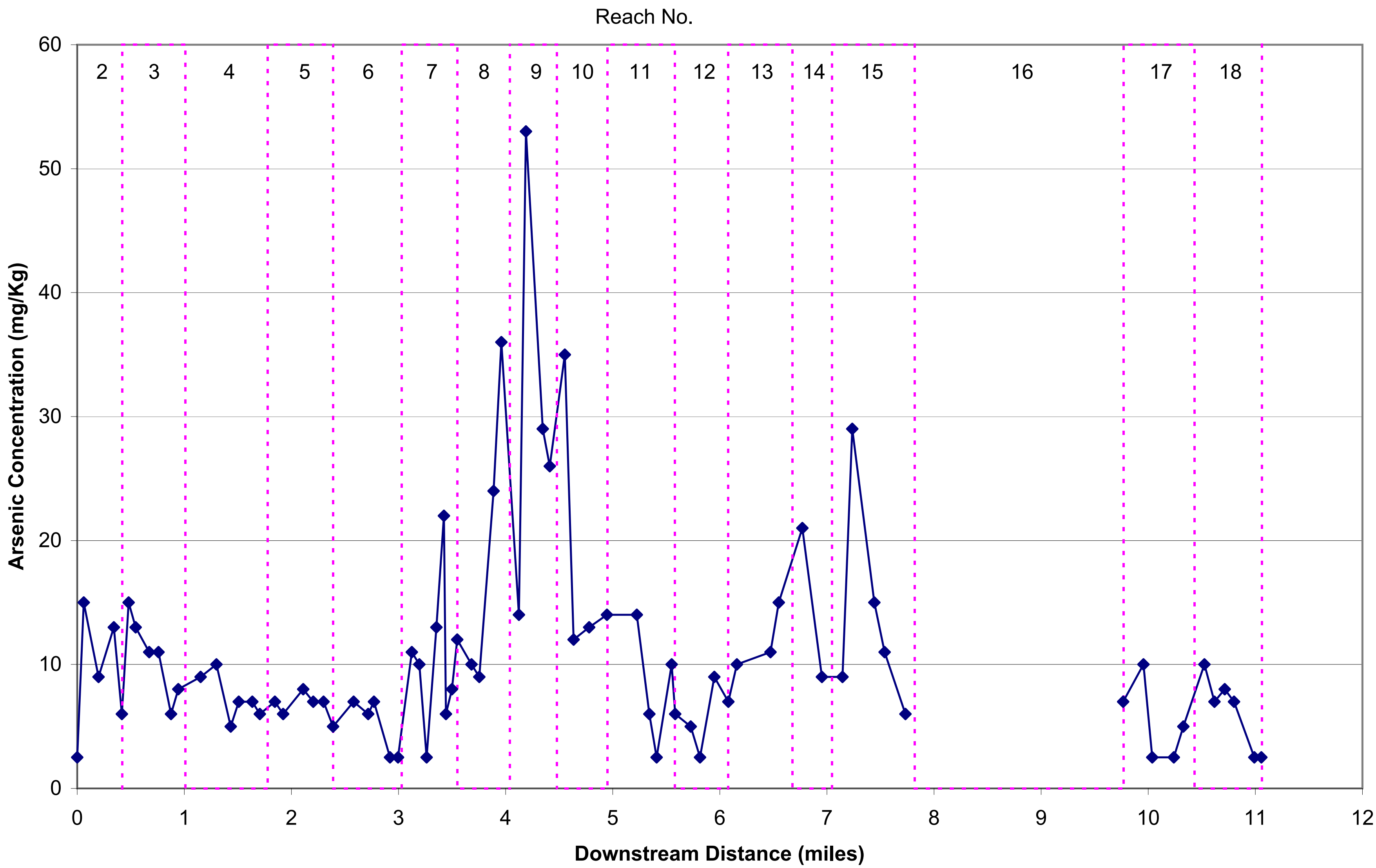


Figure 6-3b. Copper in Silver Creek Stream Sediments

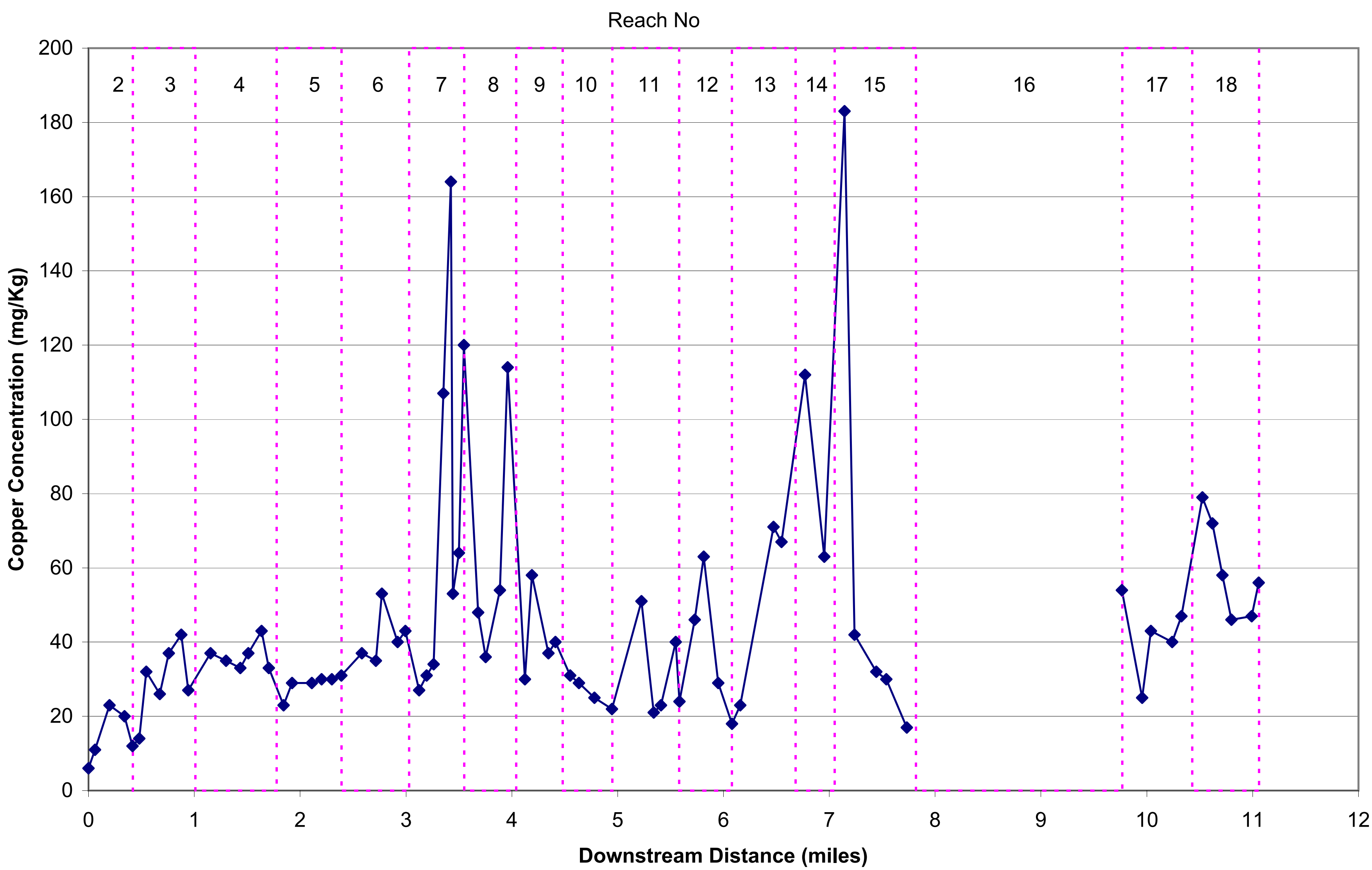


Figure 6-3c. Lead in Silver Creek Stream Sediments

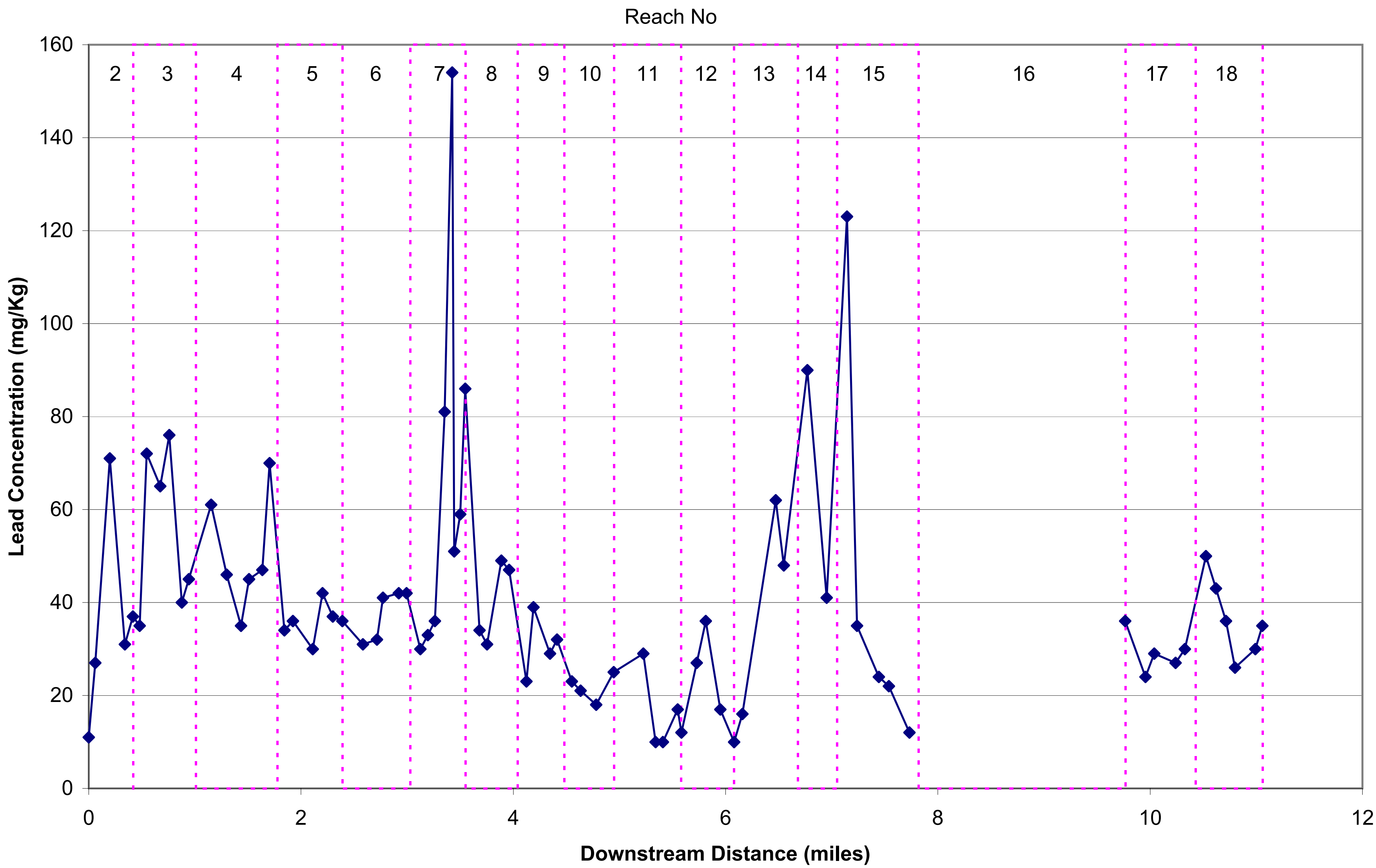


Figure 6-3d. Mercury in Silver Creek Sediments

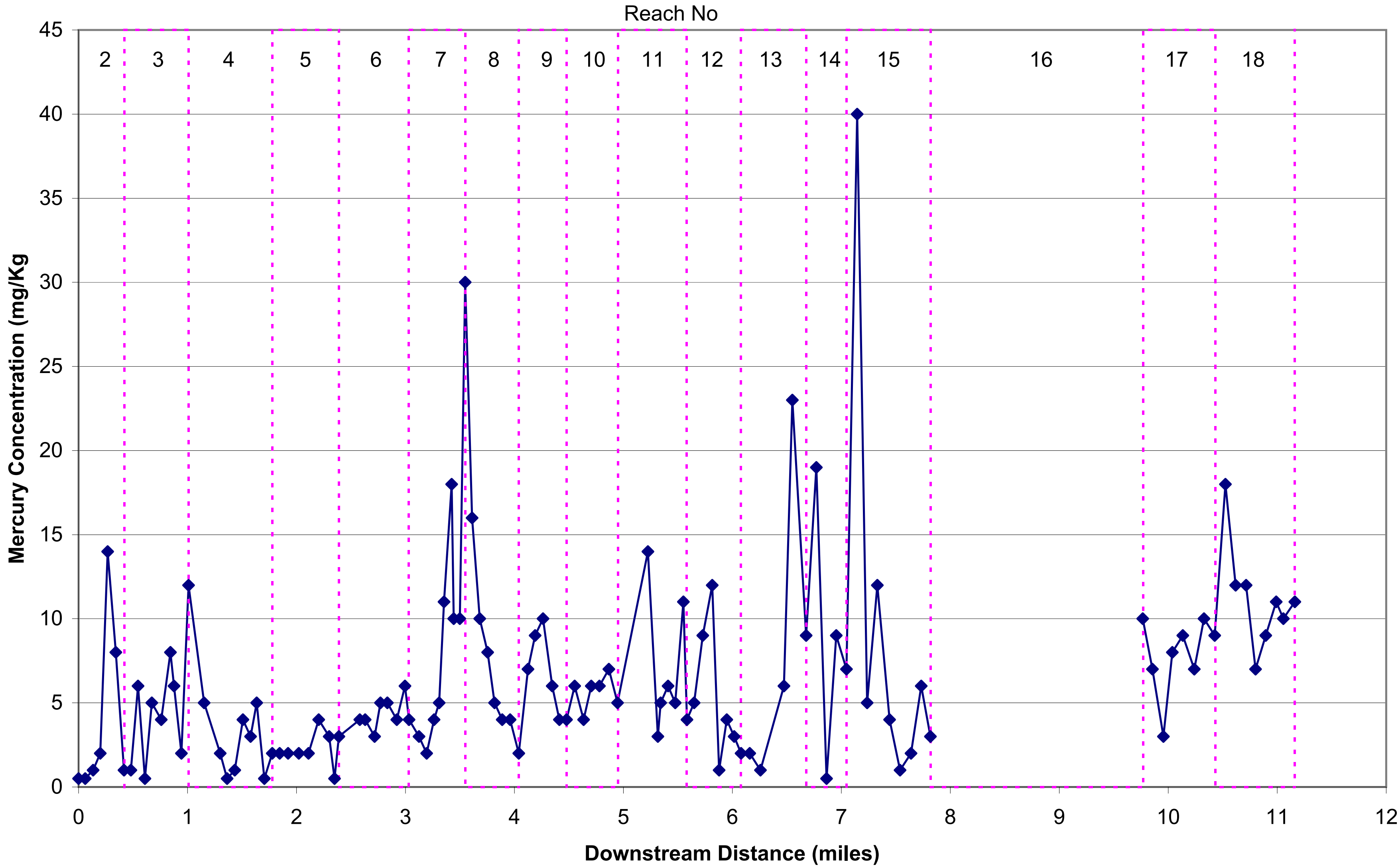


Figure 6-3e. Zinc in Silver Creek Stream Sediments

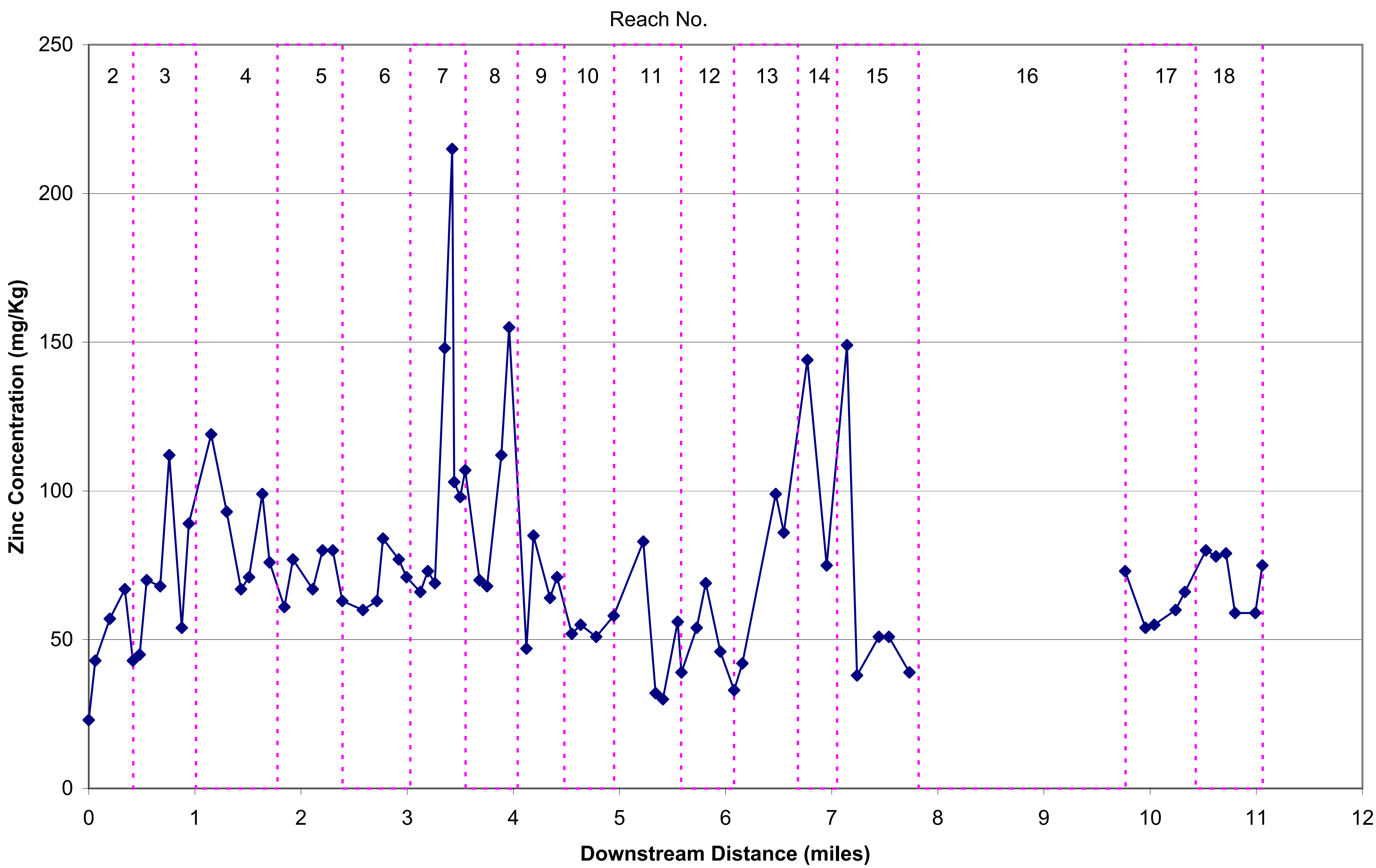


Figure 6-3f. Arsenic, Copper, Lead, Mercury and Zinc in Jennies Fork Stream Sediments

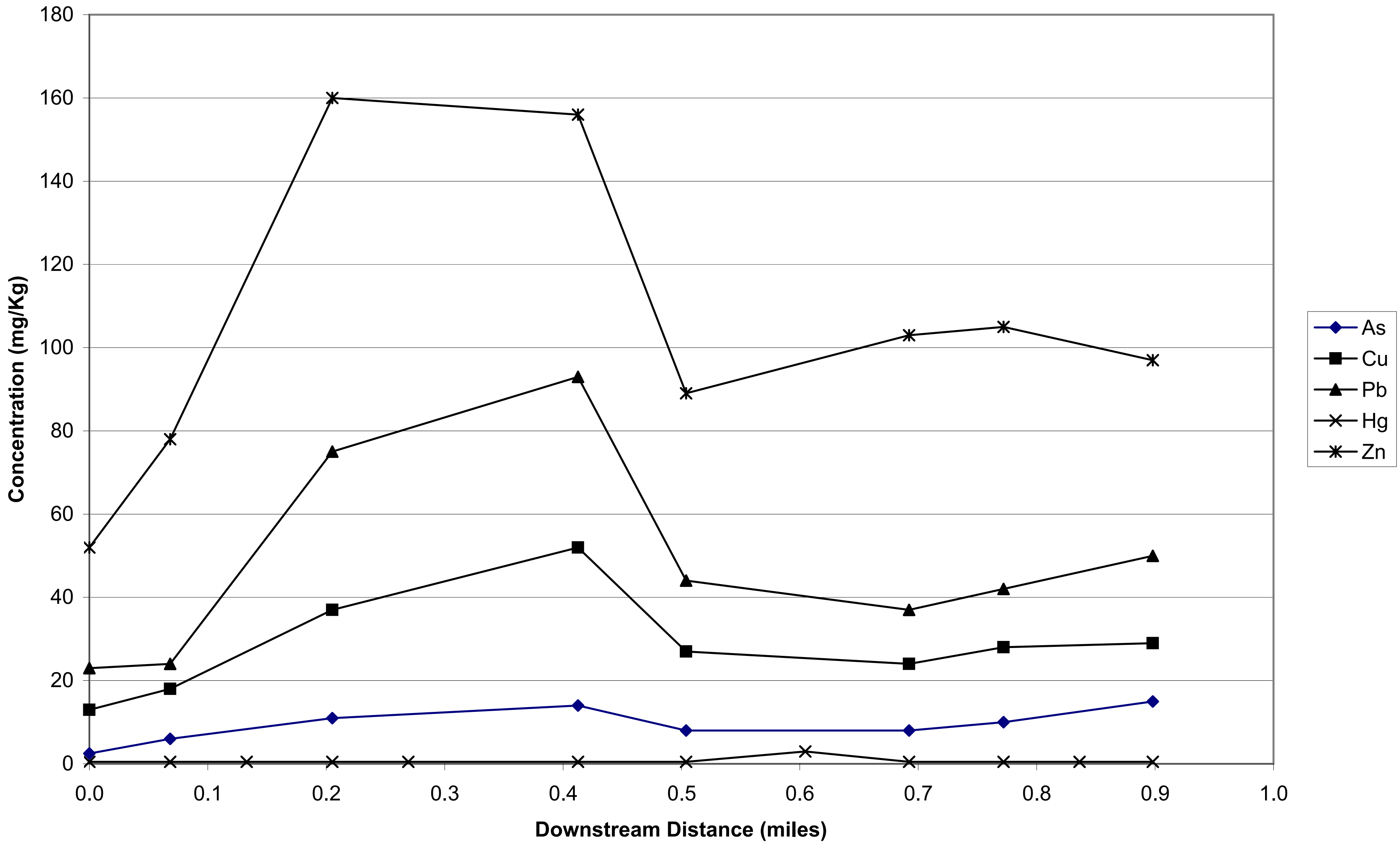


Table 6-2. Laboratory Chemistry Summary Statistics for Stream Sediments by Reach

	Reach Mean					Reach Median					Reach Maximum				
Reach	As* (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg* (mg/Kg)	Zn (mg/Kg)	As* (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg* (mg/Kg)	Zn (mg/Kg)	As* (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg* (mg/Kg)	Zn (mg/Kg)
1	9.3	30.1	49.0	0.7	107.2	9.0	28.0	44.0	0.5	103	15.0	52.0	93.0	3	160
2	8.6	14.3	34.3	3.4	45.7	7.5	13.0	30.0	1	43	15.0	23.0	71.0	14	67
3	10.7	29.7	55.5	4.9	73.0	11.0	29.5	55.0	5	69	15.0	42.0	76.0	12	112
4	7.3	36.3	50.7	2.6	87.5	7.0	36.0	46.5	2	84.5	10.0	43.0	70.0	5	119
5	6.7	29.4	36.3	2.4	73.4	7.0	30.0	36.0	2	77	8.0	34.0	42.0	4	86
6	5.0	41.6	37.6	4.4	71.0	6.0	40.0	41.0	4	71	7.0	53.0	42.0	6	84
7	10.1	72.2	64.2	10.2	108.0	10.0	53.0	51.0	9.5	98	22.0	164.0	154.0	30	215
8	19.8	63.0	40.3	7.0	101.3	17.0	51.0	40.5	5	91	36.0	114.0	49.0	16	155
9	30.5	41.3	30.8	6.7	66.8	27.5	38.5	30.5	6.5	67.5	53.0	58.0	39.0	10	85
10	18.5	26.8	21.8	5.7	54.0	13.5	27.0	22.0	6	53.5	35.0	31.0	25.0	7	58
11	7.7	31.8	15.6	6.9	48.0	6.0	24.0	12.0	5	39	14.0	51.0	29.0	14	83
12	6.3	36.8	21.2	5.0	49.4	7.0	29.0	17.0	4	46	9.0	63.0	36.0	12	69
13	12.0	53.7	42.0	8.2	75.7	11.0	67.0	48.0	6	86	15.0	71.0	62.0	23	99
14	12.7	86.7	62.7	9.1	101.0	9.0	85.0	57.0	9	84	21.0	112.0	90.0	19	144
15	14.0	60.8	43.2	9.1	65.6	11.0	32.0	24.0	4.5	51	29.0	183.0	123.0	40	149
16	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
17	5.4	41.8	29.2	7.9	61.6	5.0	43.0	29.0	8.5	60	10.0	54.0	36.0	10	73
18	6.2	59.7	36.7	11.3	71.7	7.0	57.0	35.5	11	76.5	10.0	79.0	50.0	18	80

*Values below detection limit taken as 1/2 detection limit

Figure 6-4a. Arsenic in Silver Creek Stream Sediments by Reach

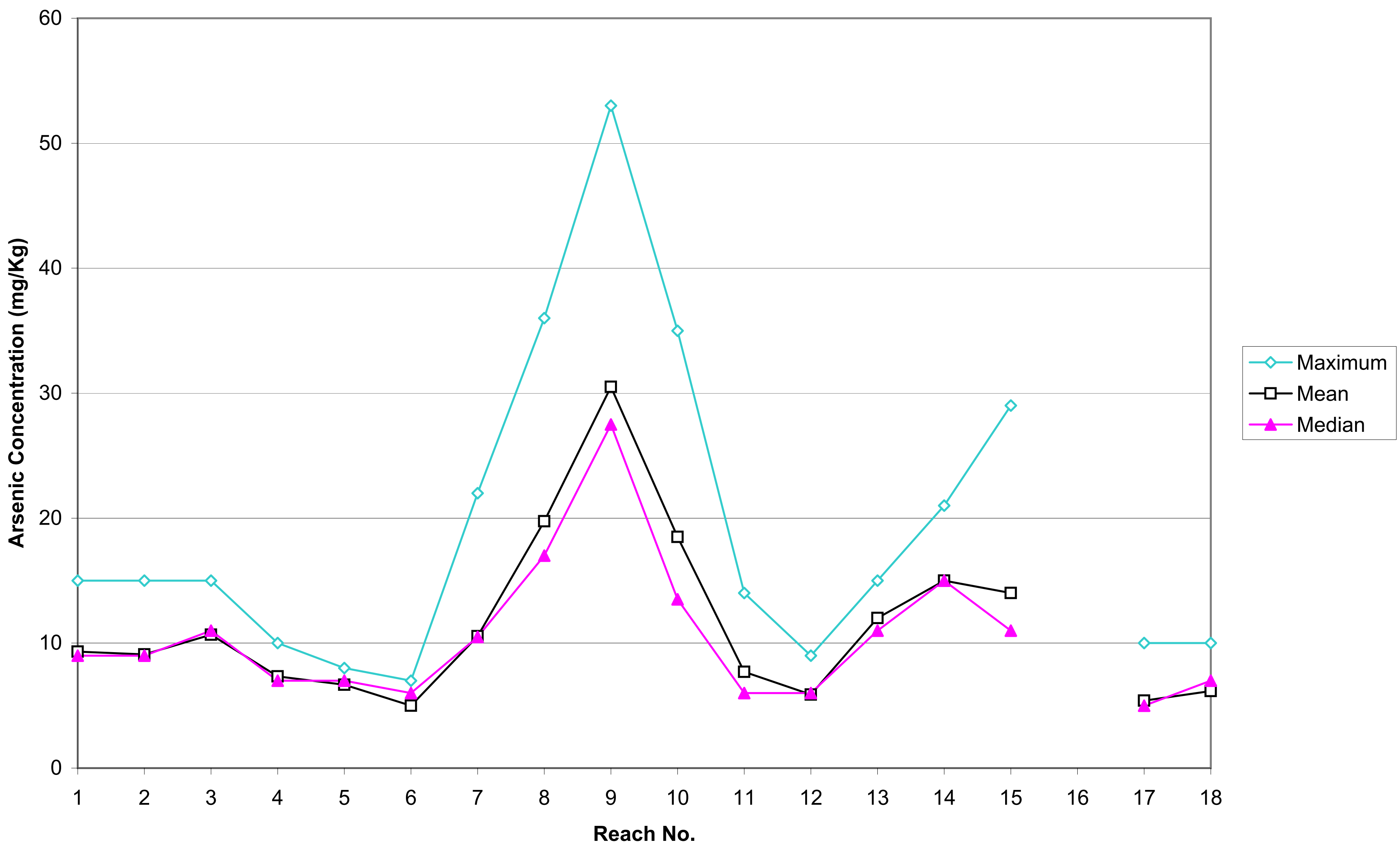


Figure 6-4b. Copper in Silver Creek Stream Sediments by Reach

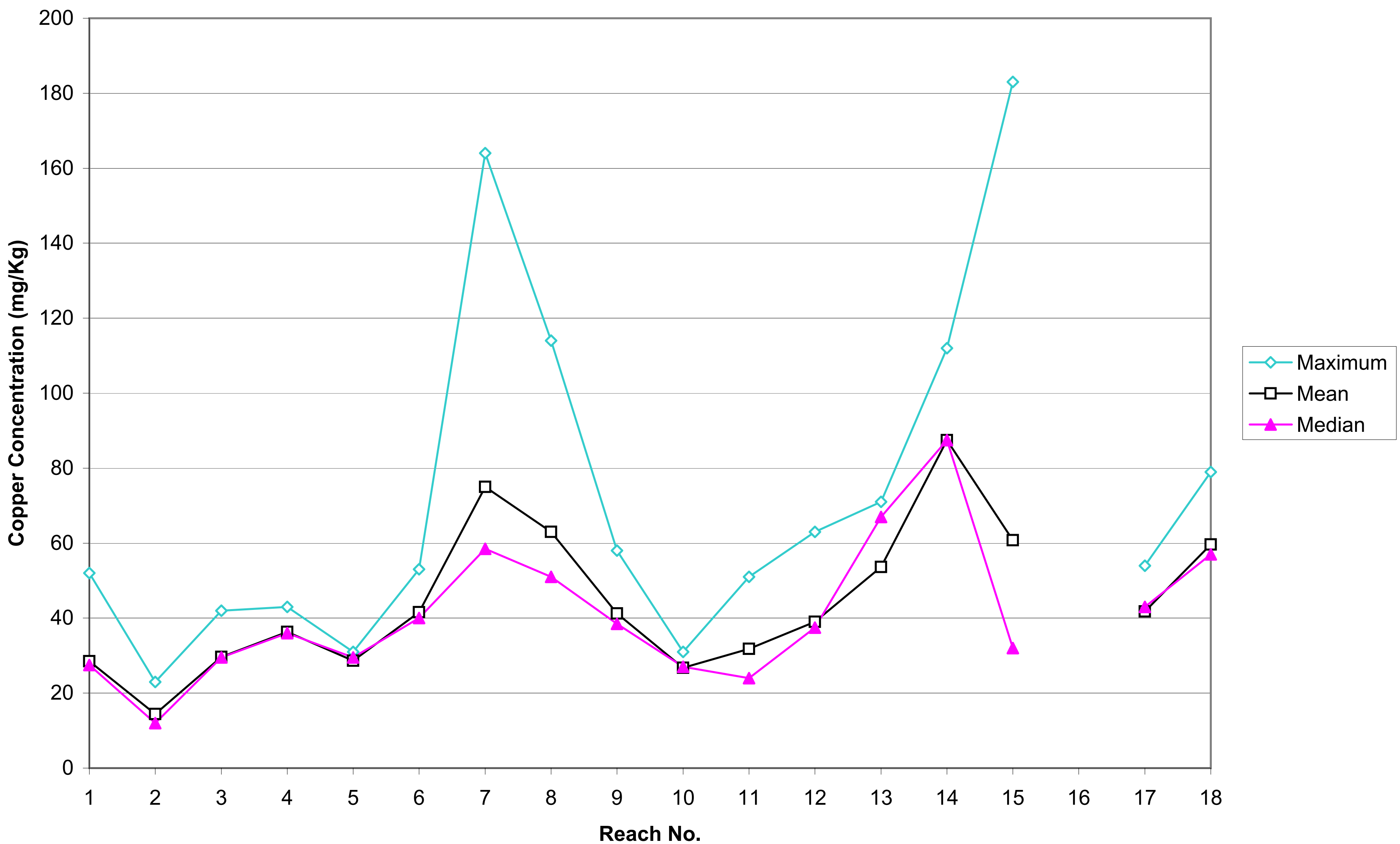


Figure 6-4c. Lead in Silver Creek Stream Sediments by Reach

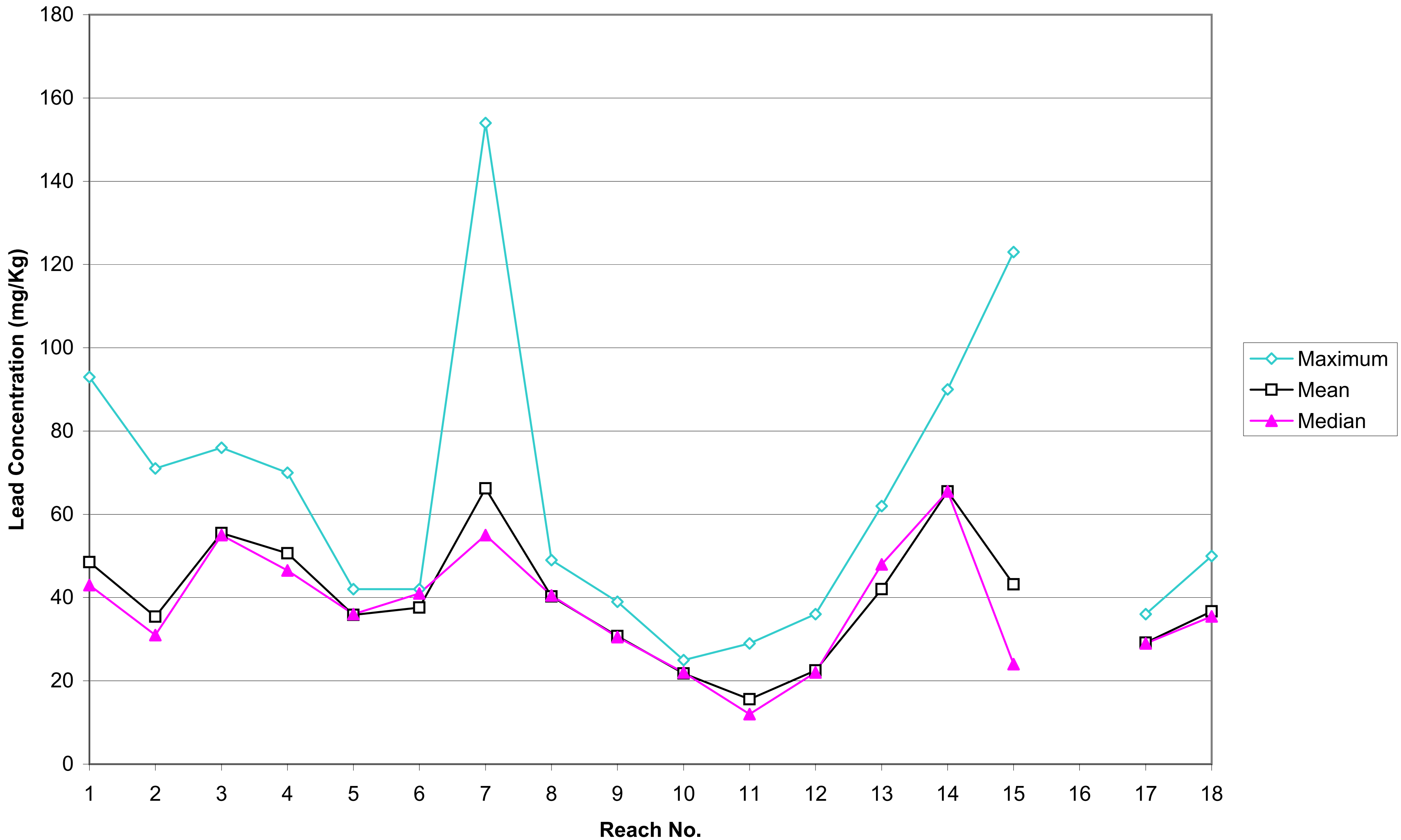


Figure 6-4d. Mercury in Silver Creek Stream Sediments by Reach

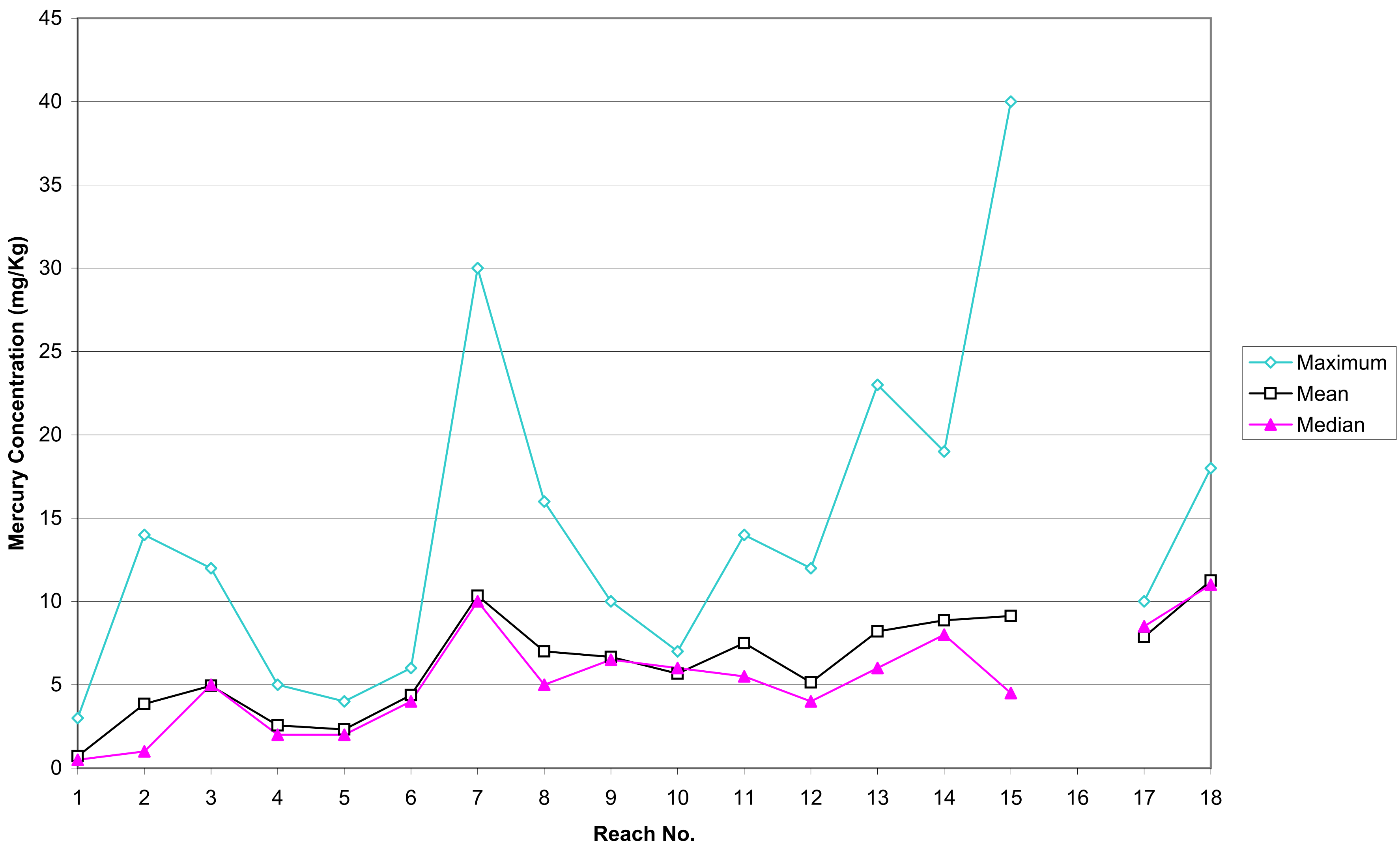


Figure 6-4e. Zinc in Silver Creek Stream Sediments by Reach

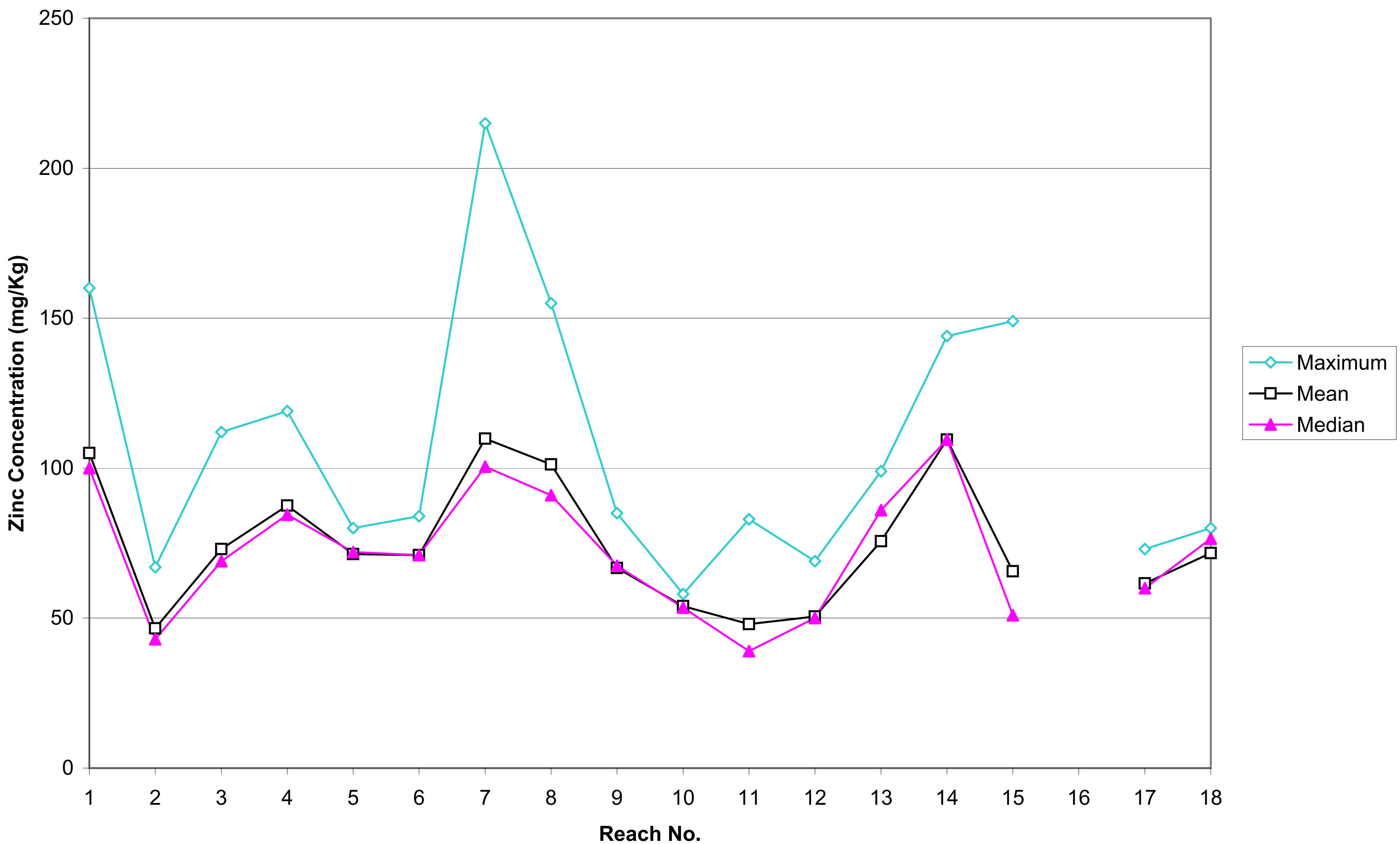


Figure 6-4a shows that the maximum, mean and median arsenic concentrations generally follow similar trends from reach to reach. The lowest maximum, mean and median arsenic concentrations occur in Reach 6, which is located upstream from the Goldsil tailings area. The arsenic concentrations increase below Reach 6 to a maximum in Reach 9 and then decrease. Arsenic concentrations are at another low in Reach 12, which is located south of the largest placer tailings and directly upstream of the pipeline crossing. Arsenic concentrations increase again below Reach 12. Reach 16 was not sampled because no land owner access agreement was in place. Arsenic concentrations decrease again in Reaches 17 and 18.

Figure 6-4b shows that the maximum, mean and median copper concentrations follow generally similar trends from reach to reach (with the exception of Reach 15, which shows diverging trends for maximum and mean/median copper). The maximum, mean and median copper concentrations increase sharply below Reach 5 to a peak at Reach 7, then decrease to near minimum values in Reaches 10 and 11. The concentrations increase again below Reach 11 with the highest mean and median values occurring in Reach 14. The largest maximum copper concentration occurs in Reach 15. Copper concentrations show another increasing trend in Reaches 17 and 18.

Figure 6-4c shows that the maximum, mean and median lead concentrations follow generally similar trends from reach to reach (with the exception of Reach 15, which shows diverging trends for maximum and mean/median lead). The maximum, mean and median lead concentrations increase sharply below Reach 6 to a peak at Reach 7, then decrease to minimum values in Reaches 10 and 11. The maximum observed lead concentration occurs in Reach 7. The lead concentrations increase again below Reach 11, with peak mean and median values occurring in Reach 14 that are higher than in Reach 7. The second highest lead concentration occurs in Reach 15. Lead concentrations show another increasing trend in Reaches 17 and 18.

Figure 6-4d shows that the maximum, mean and median mercury concentrations follow generally similar trends from reach to reach. The lowest mercury concentrations occur in Reaches 1 (Jennies Fork) and 2 (the uppermost reach in Silver Creek), although Reach 2 has a maximum value of 14 mg/Kg. The mercury concentrations in Silver Creek increase in Reach 3, then decrease and stabilize in Reaches 4 and 5. The mean and median mercury concentrations increase below Reach 5 to peak values in Reach 7, then have a generally decreasing trend through Reach 12. Below Reach 12, the mean and median mercury concentrations show an increasing trend. Mercury concentrations show another increasing trend in Reaches 17 and 18, and the highest mean and median mercury concentrations occur in Reach 18. The maximum observed mercury concentration occurs in Reach 15 and elevated maximum concentrations are also observed in Reaches 7, 8, 13, 14 and 18. The overall trend is that both the mean and median mercury concentrations increase as the reaches progress downstream.

Figure 6-4e shows that the maximum, mean and median zinc concentrations follow generally similar patterns from reach to reach (with the exception of Reaches 11 and 15, which show diverging trends for maximum and mean/median zinc). Jennies Fork (Reach 1) has higher zinc concentrations than most reaches in Silver Creek. Reach 2, the uppermost reach in Silver Creek, has the lowest mean/median zinc concentrations. The zinc concentrations in Silver Creek increase in Reaches 3 and 4, then decrease and stabilize in Reaches 5 and 6. The maximum, mean and median zinc concentrations increase below Reach 6 to at or near maximum values in Reaches 7 and 8, then decrease to minimum values in Reaches 10, 11 and 12. The zinc concentrations increase again below Reach 11 with the peak mean and median values occurring in Reach 14 that are approximately the same as the peaks in Reach 7. Zinc concentrations show another slight increasing trend in Reaches 17 and 18. The maximum observed zinc concentration occurs in Reach 7. High zinc concentrations also occur in Reaches 1, 8, 14 and 15.

Evaluation of the trends in arsenic, copper, lead, mercury and zinc concentrations in stream sediments show some distinctive patterns. First, the maximum, mean and median metal/metalloid concentrations typically have local minimums in Reaches 5 and/or 6, located above the Goldsil tailings and millsite, and have local maximums in Reach 7, which is adjacent to the Goldsil tailings. This indicates that the Goldsil tailings are a significant source of metals to Silver Creek, most likely from the erosion of mill tailings into Silver Creek. Second, the maximum, mean and median metal concentrations typically have a local minimum in Reaches 10, 11 or 12 and another local maximum in Reach 14. This would indicate that metals are attenuated in the beaver and placer tailings ponds that Silver Creek flows through in Reaches 10, 11 and 12. Reach 14 is located between Birdseye Road and the western-most railroad crossing. Reach 14 is also directly below the large placer tailings area (Reaches 12 and 13), and an old processing facility that was discovered during the Phase I Reconnaissance (see Section 6.4).

For the purpose of evaluating the Silver Creek stream sediment data, a geochemical anomaly will be considered to be any value that is two standard deviations greater than the median. This criterion was applied to the stream sediment data sets for arsenic, copper, lead, mercury and zinc to identify potential anomalies. Cadmium and total cyanide were not considered in the statistical evaluations because of the small number of samples that exceeded detection limits. Based on the identified criteria, concentrations that meet or exceed the following values are considered anomalous relative to the sample population: arsenic (24.06 mg/Kg), copper (94.36 mg/Kg), lead (82.93 mg/Kg), mercury (15.47 mg/Kg), and zinc (135.59 mg/Kg).

Application of the anomaly criteria to the stream sediment data revealed a total of 31 anomalous data points (relative to the sample population) as follows: arsenic (6), copper (6), lead (5), mercury (7) and zinc (7). The anomalous values occurred in Reach 1 (1 Pb and 2 Zn anomalies), Reach 7 (3 Cu, 2 Pb, 2 Hg and 2 Zn), Reach 8 (1 As, 1 Cu, 1 Hg, and 1 Zn anomaly), Reach 9 (3 As anomalies), Reach 10 (1 As anomaly), Reach 13 (1 Hg anomaly), Reach 14 (1 Cu, 1 Pb, 1 Hg and 1 Zn), Reach 15 (1 As, 1 Cu, 1 Pb, 1 Hg and 1 Zn), Reach 18 (1 Hg anomaly). The anomalous values occurred most frequently in Reach 7 (9 times), Reach 8 (4 times), Reach 14 (4 times) and Reach 15 (5 times). The occurrence of higher concentrations in Reaches 7, 8, 14 and 15 generally follows the trends observed from evaluating Figures 6-4a through 6-4e.

The stream sediment metal chemistry for this project was compared with previous sediment data (Table 2-5). The median and maximum concentrations from each data set were compared. The median (8 vs. 28.5 mg/Kg) and maximum (53 vs. 85) arsenic concentrations were lower in this study than in the previous data. Similarly, the median (<1 vs. 3.7 mg/Kg) and maximum (2 vs. 6.9 mg/Kg) cadmium concentrations were lower in this study. The median copper (35.5 vs. 42 mg/Kg) was lower in this study, but the maximum copper (183 vs. 103) was lower in the previous data. Maxim (DEQ-AMRB/Maxim, 1996) analyzed bulk and fine sediments separately for mercury. The current data was compared to the bulk sediment mercury from previous studies. The median (4 vs. 3.84 mg/Kg) and maximum (40 vs. 33 mg/Kg) mercury concentrations were higher in this study than in the previous data. The median (36 vs. 60.5 mg/Kg) and maximum (154 vs. 230 mg/Kg) lead concentrations were lower in this study than in the previous data. The median (70 vs. 123 mg/Kg) and maximum (215 vs. 296

mg/Kg) zinc concentrations were lower in this study than in the previous data. With the exception of mercury, the previous data generally show higher concentrations than data from this project. Data from this project were collected from throughout the Silver Creek drainage basin, rather than from selected locations. The data set from this project also had many more samples than the previous data, which could result in lower median concentrations. Although there are differences in the two data sets, the concentrations are generally in similar ranges.

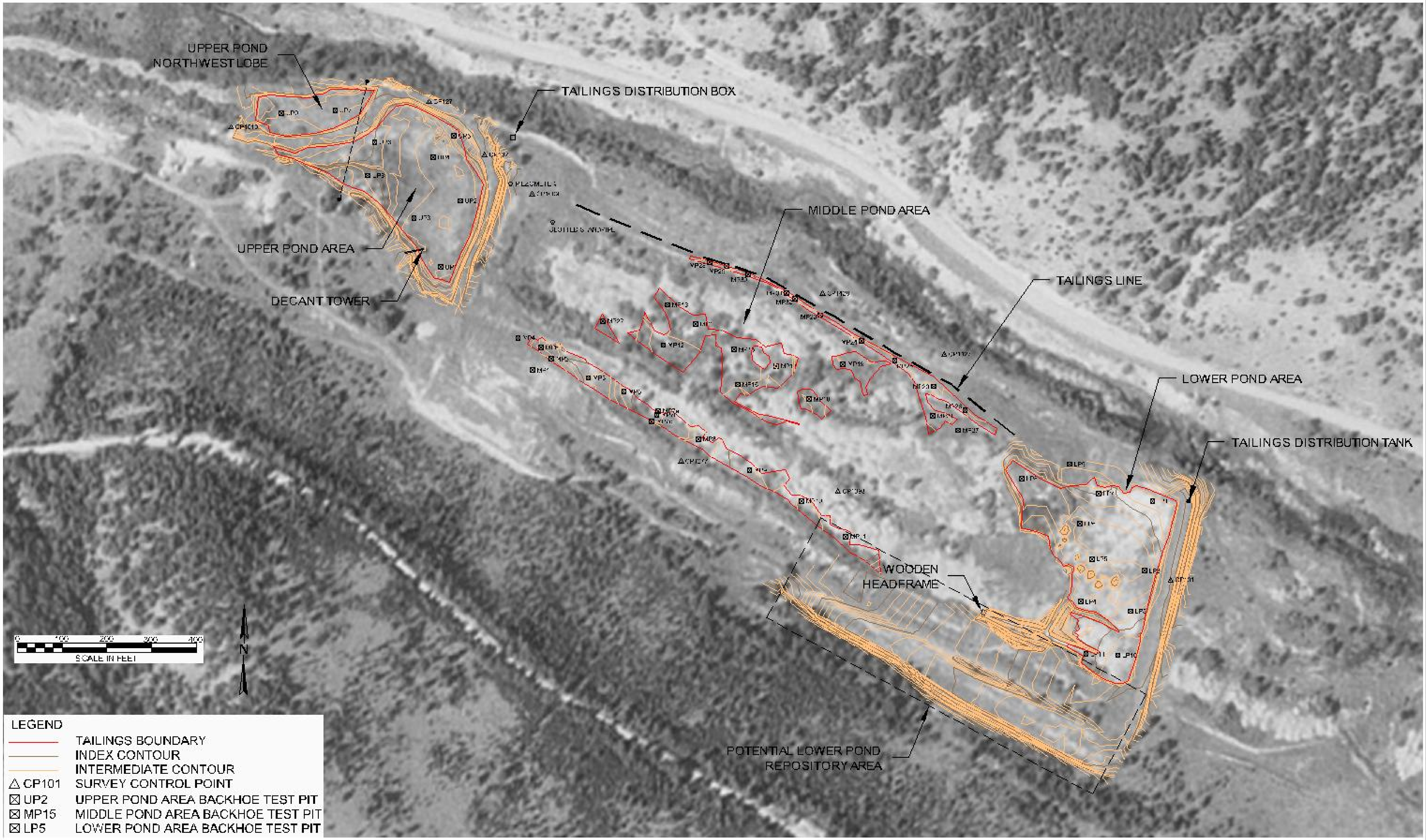
6.2 UPPER, MIDDLE AND LOWER POND AREAS

The Upper, Middle and Lower Pond areas are located on the south side of Silver Creek between the Goldsil millsite and Buck Lake (Figure 1-6). Mill tailings were encountered in the Upper, Middle and Lower Pond areas during the Phase I Reconnaissance. These tailings were most likely deposited during the late 1970's and early 1980's by operations at the Goldsil (formerly John B. White) mill. Although these areas were characterized as part of Phase I of the Silver Creek Drainage Project, the detailed characterization results are presented in the Phase II report (DEQ-MWCB/Olympus, 2003) so that all mill tailings sources are grouped in one report for comparison and evaluation. The following is a brief description of the Upper, Middle and Lower Pond areas. Figure 6-5 is an aerial photograph of the Upper, Middle and Lower Pond areas with topographic survey contours of the tailings area superimposed on the photo.

The Upper Pond (UP) is formed by placer tailings overburden piles on the north, west and south sides, and by an earthen dam on the east end. The fill for the dam was probably excavated from a borrow area located southeast of the dam. The UP consists of a main tailings area and a smaller lobe located to the northwest that is separated from the main tailings by a berm. The estimated volume of the UP tailings is 17,400 cubic yards for the main tailings and 3,320 cubic yards for the northwest lobe. The tailings plan areas are 1.79 and 0.44 acres for the main tailings and northwest lobe, respectively. The average tailings depths are 6.03 and 4.72 feet for the main tailings and northwest lobe, respectively. The maximum tailings thickness measured in the test pits was 10.5 feet. A total of 8 test pits and one hand auger boring were excavated in the UP tailings (Figure 6-5).

A decant tower is located near the southeast corner of the UP (Figure 6-5). Tailings are typically deposited in a tailings pond in slurry form. The purpose of a decant tower is to collect and remove clear water from the pond surface after the tailings have settled. Just below the north end of the UP dam is a 3-foot by 3-foot metal box containing tailings. This box was possibly a distribution box for a tailings line. Portions of an old tailings line were observed between the distribution box and the Lower Pond (LP). The tailings line consists of an 8-inch outside diameter wooden pipe with metal banding in 10 foot lengths. A total of 82 sections of pipe were observed between the UP dam and the LP tailings. The approximate alignment of the tailings line is shown on Figure 6-5. Tailings were observed in many broken sections of the pipe, confirming that it was used as a tailings line. Dilapidated 2-inch by 4-inch wooden timbers used for a pipe trestle structure were observed throughout much of the tailings line area.

The Lower Pond is formed by placer tailings overburden piles on the north and south sides, processed placer tailings on the west side, and by an earthen dam on the east end. A borrow area located directly south of the LP was probably the source of the LP dam fill. This borrow area is a potential repository location (Section 8.0). There are a series of processed placer tailings piles located within the LP and mill tailings have been deposited over portions of the processed placer tailings.



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NO	REVISION DESCRIPTION	BY	DATE	SCALE: AS SHOWN	FILENAME: A1234Ponds.dwg	

MONTANA DEQ/MINE WASTE CLEANUP BUREAU
SILVER CREEK DRAINAGE PROJECT
LEWIS & CLARK COUNTY, MONTANA

Olympus Technical Services, Inc.

UPPER, MIDDLE AND
LOWER POND AREAS

FIGURE
6-5

The estimated volume of the LP tailings is 20,710 cubic yards including an area of processed placer tailings that are mostly covered with tailings. Only the tops of the placer tailings piles are visible and form small "islands" within the mill tailings deposits. The volume of placer tailings piles within the LP tailings are estimated at 3,040 cubic yards. The tailings volume excluding the placer tailings piles is 17,670 cubic yards. The tailings plan area is 1.77 acres, excluding the placer pile area, and the average tailings depth is 6.20 feet. The maximum tailings thickness measured in the test pits was 14.0 feet. A total of 11 test pits were excavated in the LP tailings.

A 4-foot diameter by 4-feet high tank was observed on the north end of the LP dam. This tank was approximately ¾ full of tailings, and was probably a distribution box for the tailings line. An assortment of PVC pipe and hoses were observed near the tank. These pipes and hoses were probably connected to the distribution box and used as spigot lines to discharge tailings into the LP.

A wooden headframe was observed approximately 350 feet northwest of the southeast corner of the LP dam. A ditch extends from near the LP dam to the headframe. The headframe has a wood frame and steel I-beams with attached chains and a wooden deck. Below the wooden deck is a 3-foot diameter round screen. A power pole and old electrical panel box are located near the headframe. The ditch and headframe were possibly associated with a water collection system for the LP.

Tailings in the Middle Pond (MP) area were deposited in several areas between existing overburden and processed placer tailings piles (Figure 6-5). The MP and LP areas are separated by processed placer tailings piles that have been graded out. Tailings along the northern perimeter of the MP are associated with spillage from the tailings line between the UP and LP dams and are primarily contained in a ditch adjacent to the line. The tailings along the southern perimeter of the MP area were most likely spilled or discharged starting approximately 200 feet from the southern end of the UP dam. These tailings were deposited in a narrow, linear configuration between placer tailings piles.

Tailings in the central portion of the MP are found in pockets between placer tailings piles (Figure 6-5). The origin of deposition of these tailings was not visible in the field. Theories as to how these tailings were deposited include: 1) the tailings were deposited via another discharge line that has been removed, or 2) tailings could have overflowed from the north and south MP tailings areas in gaps between the hummocky placer piles. The first theory is more likely. A temporary pipe could have been run from the distribution box on the UP dam to the central portion of the MP area to discharge the tailings. This could also be how the tailings along the southern MP perimeter were discharged. The second theory is possible but less likely. It is conceivable that tailings slurry could pond up and flow through gaps in the placer tailings piles; however, direct evidence of this was not observed. A small rock berm was observed near the west end of the southern MP tailings area. It is possible that a gap in the placer tailings piles could have existed prior to placement of this berm; however, the MP tailings deposition areas appeared in the field to be completely separated.

A slotted metal standpipe was observed between the MP and UP areas (Figure 6-5). The pipe is an 8-inch diameter steel casing with slots cut in it by a cutting torch. The pipe could have been used for dewatering the MP area, although no tailings were identified in this area.

6.3 PLACER TAILINGS PILES

Placer tailings are contained throughout much of the Silver Creek Drainage Project area, but most are concentrated in the area between the Goldsil millsite and Birdseye Road. Placer tailings generally exist in three forms in the Silver Creek drainage:

- older placer piles in the upper portion of the drainage (primarily above the Goldsil tailings) from early placer operations;
- fine-grained, unprocessed overburden piles that were stripped to allow access to the stream gravels/cobbles; and
- coarse-grained rock piles consisting of stream gravels and cobbles.

Most of the older, upstream placer workings appear to have been small operations where individuals probably hand shoveled stream gravel for gold processing by panning and/or sluice box methods or larger areas that were mined by hydraulicking. The volume of placer tailings increases significantly below the Goldsil millsite probably due to the use of mechanized placer methods employing dredges. No detailed topographic surveys nor volume estimates were done for the placer tailings. Reconnaissance surveys were done to show the approximate location of the more significant placer tailings areas. Figures 1-7 and 1-8 show the location of the larger tailings piles. Many of the overburden-type placer tailings piles in the Silver Creek drainage have established stands of vegetation and are for the most part naturally reclaimed.

A group of placer tailings piles are located on a bench north of Silver Creek, between Little Falcon Road and Birdseye Road. The bench appears to have been mined by a dragline dredge. There are a few small overburden piles located along the northern perimeter of the bench area. The remaining placer tailing piles in the interior are coarse-grained gravels and cobbles. A sporting clay shooting range is now located in this area. The range has numerous shooting stations which are strategically located to use the placer tailings piles to separate the stations. The objective of the placer tailings characterization was the large area between the Goldsil millsite and Birdseye Road.

6.3.1 Placer Tailings Metals/pH Chemistry Results

A total of 38 placer tailings samples were collected and screened for a multi-element suite using a portable XRF analyzer. The XRF analytical results are presented in Appendix C. The XRF analytical results were generally below detection limits, indicating that the metal concentrations are generally low. Eight composite samples were prepared for quantitative laboratory analysis. Five of the composite samples were from near-stream sources and were composited by stream reach to evaluate the chemistry of fine-grained placer tailings piles. The remaining placer pile samples were composited from a placer tailings pile located along Marysville Road (just west of the intersection with Little Falcon Road), from west of the Upper Pond and from south of the Lower Pond. The three composite samples from outside of the immediate stream corridor were also evaluated for borrow source suitability as presented in Section 6.3.2. The placer tailings sample locations are shown on Figure 6-6.

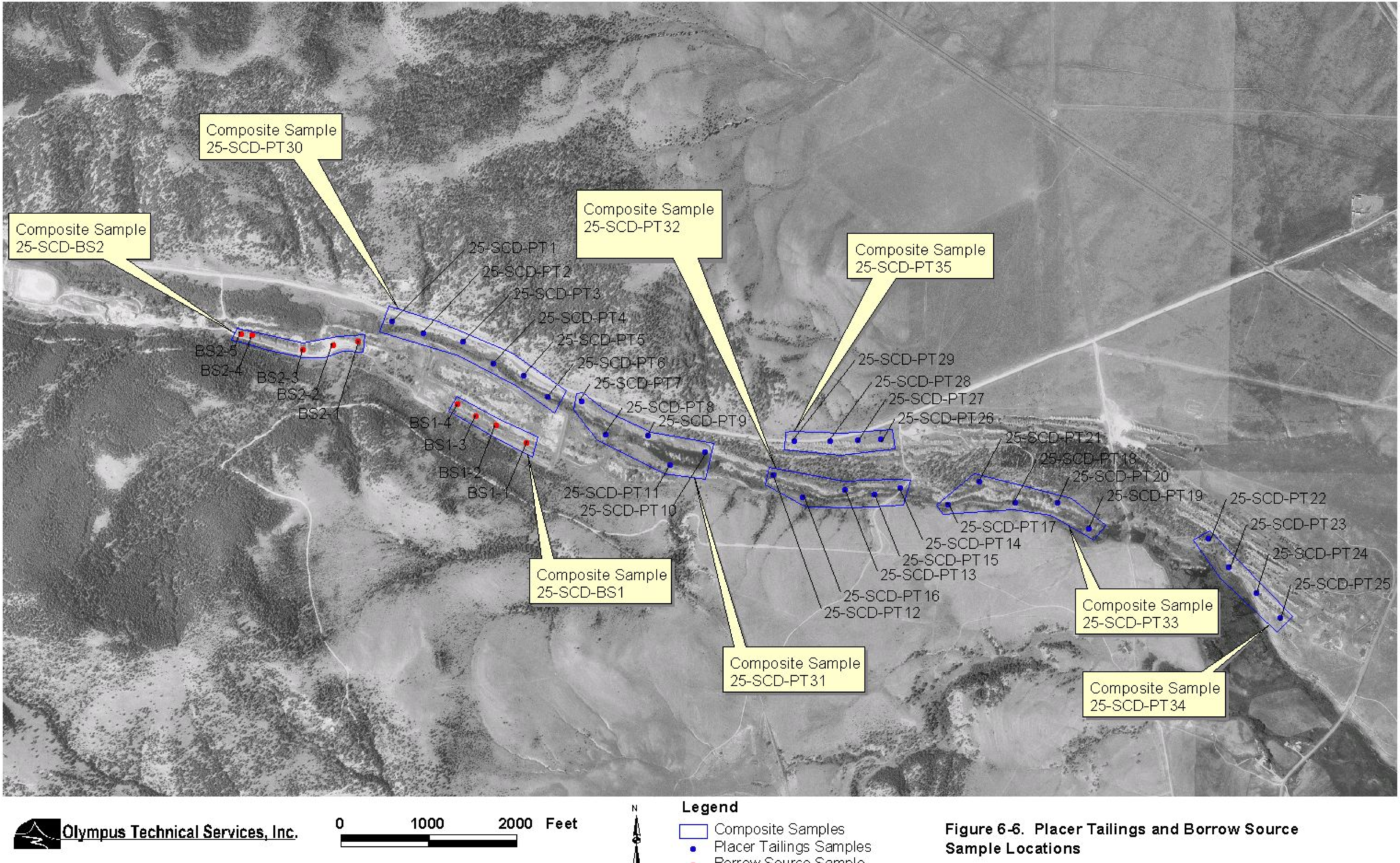


Figure 6-6. Placer Tailings and Borrow Source Sample Locations

The placer tailings laboratory chemistry results are presented in Table 6-3, and the laboratory analytical reports are contained in Appendix B. Arsenic concentrations in the laboratory composite samples ranged from 18 to 52 mg/Kg, with a mean of 28.4 mg/Kg. Cadmium concentrations were below the detection limit of 1 mg/Kg in all composite placer tailings samples. Copper concentrations ranged from 16 to 43 mg/Kg, with a mean of 28.9 mg/Kg. Lead concentrations ranged from 12 to 44 mg/Kg, with a mean of 21.6 mg/Kg. Mercury concentrations ranged from <1 mg/Kg to 7 mg/Kg, with a mean of 2.6 mg/Kg. The mean concentration of placer tailings composite samples with detectable mercury was 3.8 mg/Kg. Zinc concentrations ranged from 34 to 71 mg/Kg, with a mean of 56.0 mg/Kg. Total cyanide concentrations were less than the detection limit of 0.5 mg/Kg in all of the placer tailings composite samples. Paste pH values ranged from 7.2 to 8.1 SU, with a mean of 7.7 SU.

The following are the laboratory mean concentrations for each element analyzed in the placer tailings composite samples relative to the mean background concentration: As (1.13x), Cu (0.85x), Pb (1.91x), Hg (>5.2x) and Zn (0.81x). With the exception of mercury, the mean element concentrations are near mean background soil concentration or are not significantly elevated above background.

Of the eight composite samples collected, five contained mercury above the detection limit. Three of these samples were located out of the main stream corridor, and two were located within the stream corridor. The highest mercury concentration (7 mg/Kg) was observed in the placer tailings piles along Silver Creek in Reach 12. The second highest mercury concentration (4 mg/Kg) was observed in the placer tailings piles along Silver Creek in Reach 11. The remaining detectable mercury concentrations were observed in the placer tailings pile along Marysville Road (3 mg/Kg), in a placer tailings pile along the southern perimeter of the Lower Pond (3 mg/Kg) and in a placer tailings pile west of the Upper Pond (2 mg/Kg).

6.3.2 Placer Tailings Borrow Source Suitability

Three composite samples from the placer tailings area were analyzed for revegetation suitability parameters to evaluate borrow source suitability. These revegetation parameters include: N (as NO_3)-P-K, organic matter percent, pH, conductivity (salt hazard), saturation percent, soil texture class, and particle size analysis. The results of the revegetation samples are presented in Table 6-4 and the laboratory analytical reports are contained in Appendix B. The borrow source samples were collected from backhoe test pits and the test pit logs are presented in Appendix D.

The soil textures of the potential borrow sources that were evaluated were loam and silty loam. These types of textures are well suited for supporting vegetation.

The MWCB's standard construction specifications (MDSL/AMRB, 1991) has the following requirements for imported cover soil:

- Sand and silt content each less than 70 percent.
- Clay content less than 40 percent.
- Soil pH between 5.5 and 8.0;
- Soil saturation percent less than 85 percent and greater than 25 percent.

Table 6-3. Laboratory Chemistry Results for Placer Tailings

Sample ID	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg* (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)	Paste pH	Comment
25-SCD-BS1	19	<1	34	21	3	59	<0.5	8.1	Composite of BS1-1, BS1-2, BS1-3 & BS1-4
25-SCD-BS2	52	<1	29	19	2	60	<0.5	8.1	Composite of BS2-1, BS2-2, BS2-3, BS2-4 & BS2-5
25-SCD-PT-30	18	<1	23	17	<1	55	<0.5	7.5	Composite of PT1, PT2, PT3, PT4, PT6 & PT6
25-SCD-PT-31	21	<1	19	15	<1	53	<0.5	7.4	Composite of PT7, PT8, PT9, PT10 & PT11
25-SCD-PT-32	42	<1	35	23	4	59	<0.5	7.6	Composite of PT12, PT13, PT14, PT15 & PT16
25-SCD-PT-33	32	<1	43	44	7	71	<0.5	7.6	Composite of PT17, PT18, PT19, PT20 & PT21
25-SCD-PT-34	19	<1	16	12	<1	34	<0.5	7.2	Composite of PT22, PT23, PT24 & PT25
25-SCD-PT-35	24	<1	32	22	3	57	<0.5	8.1	Composite of PT26, PT27, PT28 & PT29
Mean	28.4	<1	28.9	21.6	2.6	56.0	<0.5	7.7	
Maximum	52	<1	43	44	7	71	<0.5	8.1	
Minimum	18	<1	16	12	<1	34	<0.5	7.2	

Table 6-4. Laboratory Revegetation Sample Results

Sample ID	Physical Characteristics Sand (wt%)	Silt (wt%)	Clay (wt%)	Texture*	Chemical Characteristics Conductivity, Saturated Paste (mmhos/cm)	Saturation (wt%)	Organic Matter (wt%)	Phosphorus mg/Kg	Nitrate as N mg/Kg	Potassium mg/Kg
25-SCD-PT35	30	48	22	L	0.46	37.6	0.97	4	<1	160
25-SCD-BS1	18	56	26	SiL	1.03	44.2	1.38	5	1	170
25-SCD-BS2	26	50	24	SiL	1.61	39.4	1.26	5	6	17

*C=Clay, S=Sand(y), Si=Silt(y), L=Loam(y)

- Soil conductivity less than 4 mmhos/cm.

- Organic content not less than 1 percent and not greater than 20 percent.

As shown in Table 6-4, the sand, silt and clay content, conductivity and saturation all fall within the specifications. Two of the three borrow source samples meet the minimum organic matter content of 1 percent and the third sample is just below the minimum (0.97 percent). The paste pH of the three placer tailings revegetation samples are all 8.1 SU, which is just outside the limit recommended in the MWCB standard specifications; however, these potential borrow soils are currently supporting good stands of natural vegetation and the pH should not be a significant problem for revegetation. Based on these results, the three potential borrow sources meet the MWCB specifications, although some organic amendment may be required. As presented in Section 6.3.1, all three borrow source samples contained mercury concentrations of 2 to 3 mg/Kg.

No potential native soil borrow sources were identified during the reconnaissance characterization. The upper portion of the Silver Creek drainage is generally narrow, with steep side slopes. This type of terrain generally has thin topsoil and subsoil layers, bedrock at shallow depths and is generally not conducive to development of cover soil borrow sources. The lower portion of Silver Creek, below Little Falcon Road, has more gentle side slopes and is generally more open. This area is more likely to contain the desired type of cover soil material; however, it is much more developed, particularly below Birdseye Road. As shown on Figures 3-1a through 3-1e, there are more small land parcels, and the current level of development and multiple landowners may make it difficult to develop borrow sources in this area. Potential borrow sources from the lower portion of Silver Creek also have an increased haulage distance from potential repository sites, which make them more costly and less economically feasible.

Although the potential borrow source piles were not surveyed, the pile dimensions were measured to provide order of magnitude estimates of available borrow material. The following are estimates of borrow source volumes: west of the Upper Pond (11,100 cubic yards), south of the Lower Pond (7,800 cubic yards) and along Marysville Road (10,800 cubic yards). Another fine-grained placer tailings pile was observed west of the Upper Pond but was not sampled. This pile could potentially yield another 2,100 cubic yards of cover soil.

6.3.3 Placer Tailings Weed Evaluation

During the Phase I reconnaissance, Olympus observed areas where spotted knapweed is growing. Spotted knapweed was observed through the Upper, Middle and Lower Pond areas and on the placer tailings piles in the Buck Lake area. Because of the widespread presence of spotted knapweed, individual areas where it was found were not mapped. Spotted knapweed was not observed in abundance in the placer tailings on the bench north of Silver Creek between Buck Lake and Birdseye Road.

Olympus observed a spray plane apparently spraying weeds on the placer tailings piles near Buck Lake on September 15, 2002. Markers used by spray planes to track areas that have been sprayed were observed on the Goldsil tailings as well, indicating that portion of the Silver Creek drainage from the Goldsil tailings to Buck Lake had been sprayed.

6.4 VAT TANK AREA

During the Phase I reconnaissance, a set of five vat tanks, including two wood and three metal, were discovered approximately 450 feet west of Birdseye Road (Figure 1-8). The vat tanks are located on the hillside north of Silver Creek. The tanks are arranged on two different levels. The upper level consists of the two wood vat tanks and one metal tank. The lower level includes the two remaining metal tanks. The tanks are approximately 15 feet in diameter. The three metal tanks are all empty; however, the two wooden tanks are approximately ¾ full of soil material. In addition to the tanks, there is dilapidated wood framing and assorted piping that indicates that this was some type of processing facility. The piping is configured such that the tanks on the upper level would drain into the tanks on the lower level. Given its location at the lower end of the large placer tailings area, it is reasonable to conclude that the facility was likely related to processing of placer tailings.

To characterize the soil material, shovel and hand auger pits were excavated in the soil material in the wooden vat tanks. Four shovel pit/auger holes were excavated in each of the wooden vat tanks. The material encountered in the vats is a fine sand with gravel, and was very dry. Because of the fine, dry nature of the sand, it would flow readily, making it difficult to keep the holes open to sample. The holes were excavated to depth of 2 to 2.5 feet and samples were collected. One four-point composite sample was collected from each tank and was screened for a multi-element suite using a portable XRF analyzer. XRF analytical results are presented in Appendix C. A single composite sample (25-SCD-VAT), comprised of material from both vat tank samples was analyzed by Energy Laboratories for arsenic, cadmium, copper, lead, mercury, zinc, total cyanide and paste pH. The sample results are presented below and laboratory analytical reports are contained in Appendix B.

Sample ID	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)	Paste pH
25-SCD-VAT	20	<1	76	72	12	210	<0.05	7.8

The following are the laboratory concentrations for each element analyzed in the vat composite sample relative to the mean background soil concentration: As (0.8x), Cu (2.2x), Pb (6.35x), Hg (>24x) and Zn (3.1x). Based on this evaluation, lead, mercury and zinc are significantly elevated above background, although overall lead and zinc concentrations are relatively low compared to many abandoned mine sites. The laboratory results also indicate that cyanide was not used for processing in this area. The presence of elevated mercury supports the probability that this was a placer mine processing operation.

6.5 BUCK LAKE

Two composite sediment samples were collected from Buck Lake (Figure 1-7). Sample 25-SCD-BL-1 was collected from the eastern (downstream) half of Buck Lake and sample 25-SCD-BL-2 was collected from the western (upstream) half of Buck Lake. Each sample was composited from five discreet sediment samples collected from the lake bottom. The composite points are shown on Figure 6-7. The discreet samples were collected by driving a two-inch PVC pipe into the lake bottom to obtain a core sample.

Olympus Technical Services, Inc.	DRAWN: KSR	SCALE: AS SHOWN	BUCK LAKE SEDIMENT SAMPLE LOCATIONS	FIGURE 6-7
	CHECKED: CRS	JOB NO: A1284		
	DATE: 1/2003	FILE: A1284BuckLk.dwg		

Both composite samples were analyzed by Energy Laboratories for arsenic, cadmium, copper, lead, mercury, zinc, total cyanide and paste pH, and were screened for a multi-element suite using a portable XRF analyzer. The laboratory chemistry results for the Buck Lake sediment samples are presented below and the laboratory analytical results are contained in Appendix B. XRF analytical results are presented in Appendix C.

Sample ID	As (mg/Kg)	Cd (mg/Kg)	Cu (mg/Kg)	Pb (mg/Kg)	Hg (mg/Kg)	Zn (mg/Kg)	CN (mg/Kg)	Paste pH
25-SCD-BL1	5	<1	26	24	12	53	<0.5	7.7
25-SCD-BL2	6	<1	49	26	9	66	<0.5	7.5

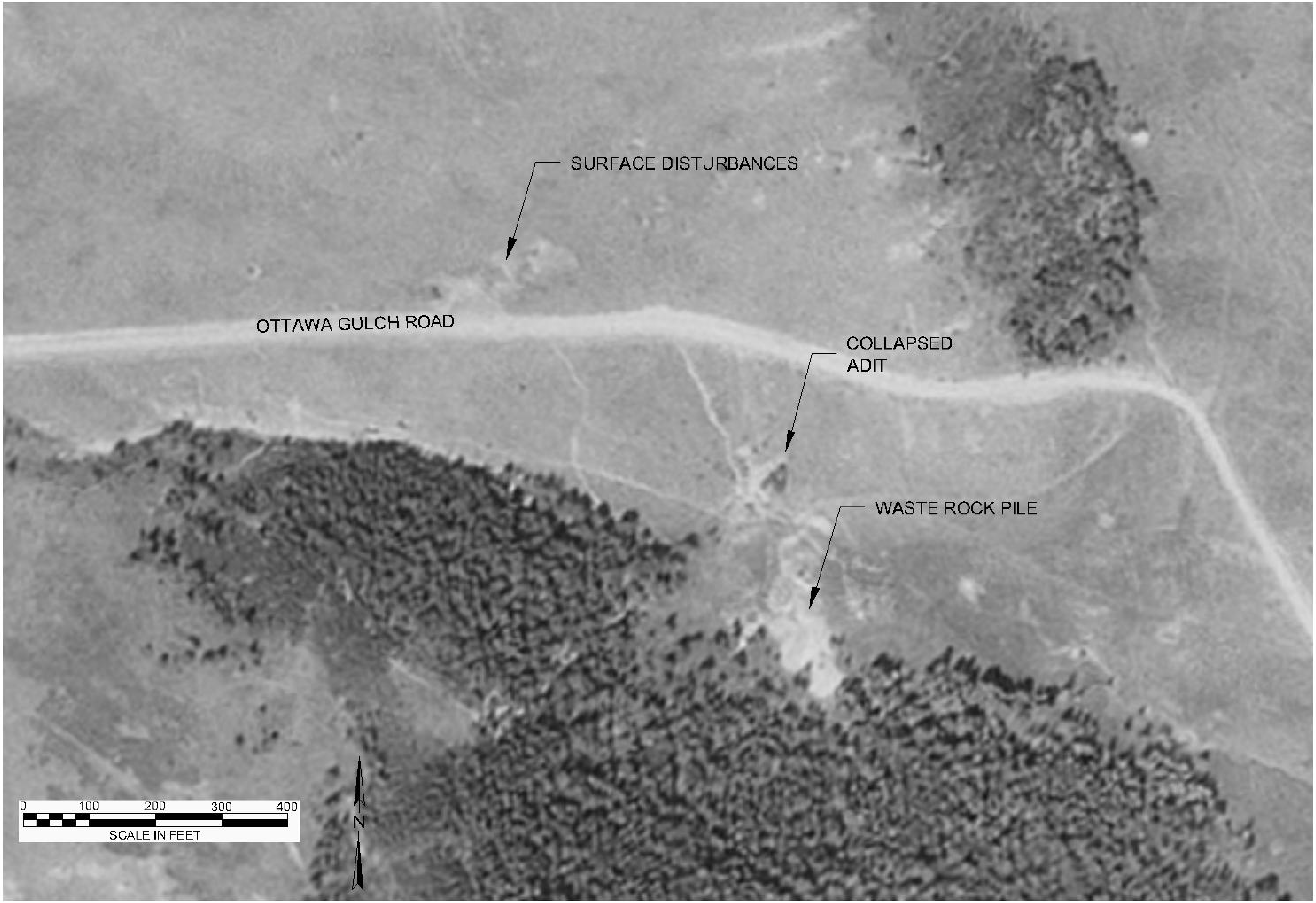
The arsenic (5 and 6 mg/Kg), copper (26 and 49 mg/Kg), lead (24 and 26 mg/Kg), mercury (9 and 12 mg/Kg) and zinc (53 and 66 mg/Kg) concentrations are within the range of concentrations found for the elements in the stream sediment samples. Cadmium concentrations were less than the laboratory detection limits.

6.6 SHANNON MINE AREA

The Shannon Mine is located in Ottawa Gulch in the Silver Creek drainage basin, approximately ¼-mile east of the Continental Divide. The site is located in the South ½ of Section 3, Township 11 North, Range 6 West. The location of the Shannon Mine is shown on Figure 1-1.

Based on Olympus' previous work at the Piegan-Gloster Millsite, located approximately 2.5 miles north of the Shannon Mine, ore from the Shannon Mine was shipped via an aerial tramway to the Gloster mill for processing. The Gloster mill was owned by the Barnes-King Development Company, which also took over operations of the Shannon Mine in 1915. A 2.5-mile aerial tramway was constructed to haul ore from the Shannon Mine to the Gloster mill. The aerial tramway operated on a gravity system in which descending buckets full of ore from the mine would haul empty buckets from the mill back to the mine. The shrink stoping mining method backfilled stopes with waste generated from development and production. Thus, much of the mine waste rock generated from the Shannon operation was not hauled out to waste rock piles on the surface. The Shannon properties continued heavy production through 1923. The mine was developed by a 650 foot shaft with more than 19,596 feet of development in levels and raises. The development proved disappointing in 1923 and the mine was closed on December 23, 1923, after the shaft pillars were mined and tools were hoisted (Knopf, 1913, Pardee and Schrader, 1933, McClernan, 1983).

Olympus completed a reconnaissance of the Shannon Mine area in November 2002. At the time of the reconnaissance, the ground was mostly clear; however, there were snow drifts covering portions of the site. The site was located in the field according to the location shown on the USGS Greenhorn Mountain 7.5 minute Quadrangle map. The map shows the mine site location to be just north of the Ottawa Gulch road. Olympus observed an area with several small surface disturbances (Figure 6-8), all of which are less than 15 feet by 15 feet in surface area. Two of these disturbances appeared to be small excavations; however, both were filled with drifted snow so the depth could not be evaluated. It is possible that the surface disturbances could be shallow prospect pits or collapsed shafts.



Olympus Technical Services, Inc.	DRAWN: KSR	SCALE: AS SHOWN	AERIAL PHOTOGRAPH OF THE SHANNON MINE AREA	FIGURE 6-8
	CHECKED: CRS	JOB NO: A1284		
	DATE: 1/2003	FILE: A1284Shannon.dwg		

Based on the reported mining/milling method, no tailings were anticipated or observed at the Shannon Mine. A waste rock pile was observed south of the Ottawa Gulch Road, directly below the Shannon Mine site (Figure 6-8). The waste rock pile is located below the opening of a collapsed adit (Figure 6-8). No seepage was observed from the adit during the reconnaissance. There was evidence of significant erosion on the west side of the collapsed adit. Surface water drainage from Ottawa Gulch Road has caused a significant erosion rill down the hillside into the west side of the collapsed adit. The adit has collapsed to the point where there is no opening; however, the erosion rill appears to be cutting into the adit area and could possibly expose the adit opening in the future.

The waste rock pile extends most of the way across the floor of Ottawa Gulch. No well-defined stream or evidence of significant erosion was observed around the toe of the waste rock pile.

The Shannon Mine was not included in the MDSL/AMRB Hazardous Materials Inventory program. Maxim (DEQ-AMRB/Maxim, 1996) reported that the site contains several small waste rock piles. A small seep at a collapsed adit, flowing at approximately one gallon per minute, was observed in September 1995. The seep was discharging at the head of Ottawa Gulch.

The scope of work for the Shannon Mine reconnaissance was strictly reconnaissance and no characterization sampling was proposed or conducted. Olympus recommends that the erosion rill at the collapsed adit below Ottawa Gulch road and the surface disturbances (possible collapsed shaft) above Ottawa Gulch Road be further evaluated as potential safety hazards.

6.7 OTHER SUSPECTED TAILINGS AREAS

During the Phase I reconnaissance, three other suspected tailings areas were identified and sampled for XRF screening. The first suspected tailings area is a small pile located adjacent to a placer tailings pile on the north side of Silver Creek between stream sediment samples SE23 and SE24. The material encountered was a light tan, uniform sandy silt material that is similar in appearance to tailings observed in the Silver Creek Drainage Project area. Sample XRF-1 was collected and screened for a multi-element suite using a portable XRF analyzer. The location of sample XRF-1 is shown on Figure 6-1b and the XRF analytical results are presented in Appendix C. The suspected tailings material is located above the Drumlummon tailings, which are reported to have been reprocessed in the past. This small pile, estimated at less than 20 cubic yards, may have been displaced to its location during removal operations for reprocessing of the tailings.

The second suspected tailings area is located along the hillside south side of Silver Creek between the Drumlummon and Goldsil tailings areas. The material encountered was a light tan, uniform sandy silt material and sample XRF-2 was collected and screened for a multi-element suite using a portable XRF analyzer. The location of sample XRF-2 is shown on Figure 6-1b and the XRF analytical results are presented in Appendix C. The suspected tailings was found on a bench above the south edge of the Silver Creek floodplain. The bench ranges from about 4 to 8 feet wide and is about 6 feet high. The bench was followed eastward and it ends at the western-most end of the Goldsil tailings pile. Suspected tailings material was observed at various locations along the bench. Remnants of an old ditch were observed along portions of the bench. Although no evidence of any infrastructure was observed, it appears that the bench could have been part of a tailings conveyance system, such as discharge pipe or wooden flume. The tailings could have been deposited from spillage from a tailings conveyance system. The length of the bench is approximately 900 feet, although suspected tailings were not observed continuously along this length. Based on an average width of 6 feet and an estimated depth of 2 feet, a conservative estimate of the tailings volume is 400 cubic yards. Since suspected tailings were not observed in all areas of the bench, the actual volume is probably less.

The third suspected tailings area observed during the reconnaissance is on the north side of Silver Creek, downstream from the Goldsil millsite and approximately 50 feet north of stream sediment sample SE-52. The material encountered was a white to light gray, uniform sandy silt material. Sample XRF-3 was collected from the suspected tailings material and screened for a multi-element suite using a portable XRF analyzer. The location of sample XRF-3 is shown on Figure 6-1b and the XRF analytical results are presented in Appendix C. The suspected tailings material is located in a depression to the north of a pond behind a man-made dam with a beaver dam spillway. The suspected tailings material is mostly void of vegetation, while the surrounding area is well vegetated with grasses. The area is circular with an estimated 30 foot diameter. The material was most likely deposited as flood-washed tailings from an upstream source and appears to be relatively thin. The estimated volume is less than 30 cubic yards.

The XRF data were used to evaluate whether these materials are tailings. The sum of the XRF copper, lead and zinc concentrations (XRF Cu+Pb+Zn) were used as a statistic to compare with the XRF results from the waste sources evaluated in the Phase I and Phase II site characterization activities. Table 6-5 provides summary statistics for XRF Cu+Pb+Zn from waste sources evaluated during Phase I and II of the Silver Creek Drainage Project. In the background samples, the XRF Cu, Pb and Zn were generally less than detection limits and the average and maximum XRF Cu+Pb+Zn concentrations were 7.2 ppm and 43 ppm, respectively. The placer tailings and borrow source samples, which both consisted of unprocessed placer tailings overburden, had average XRF Cu+Pb+Zn concentrations ranging from 67.9 to 83.1 ppm and maximum concentrations ranging from 272 to 289 ppm, respectively. XRF Cu+Pb+Zn concentrations from the Drumlummon, Goldsil, and Upper, Middle and Lower Pond tailings sources had average XRF Cu+Pb+Zn concentrations ranging from 140.8 to 703.8 ppm, respectively, and maximum concentrations ranging from 351 to 1753 ppm, respectively.

TABLE 6-5 SUMMARY STATISTICS FOR XRF Cu+Pb+Zn FOR SILVER CREEK DRAINAGE PROJECT PHASE I AND PHASE II WASTE SOURCES

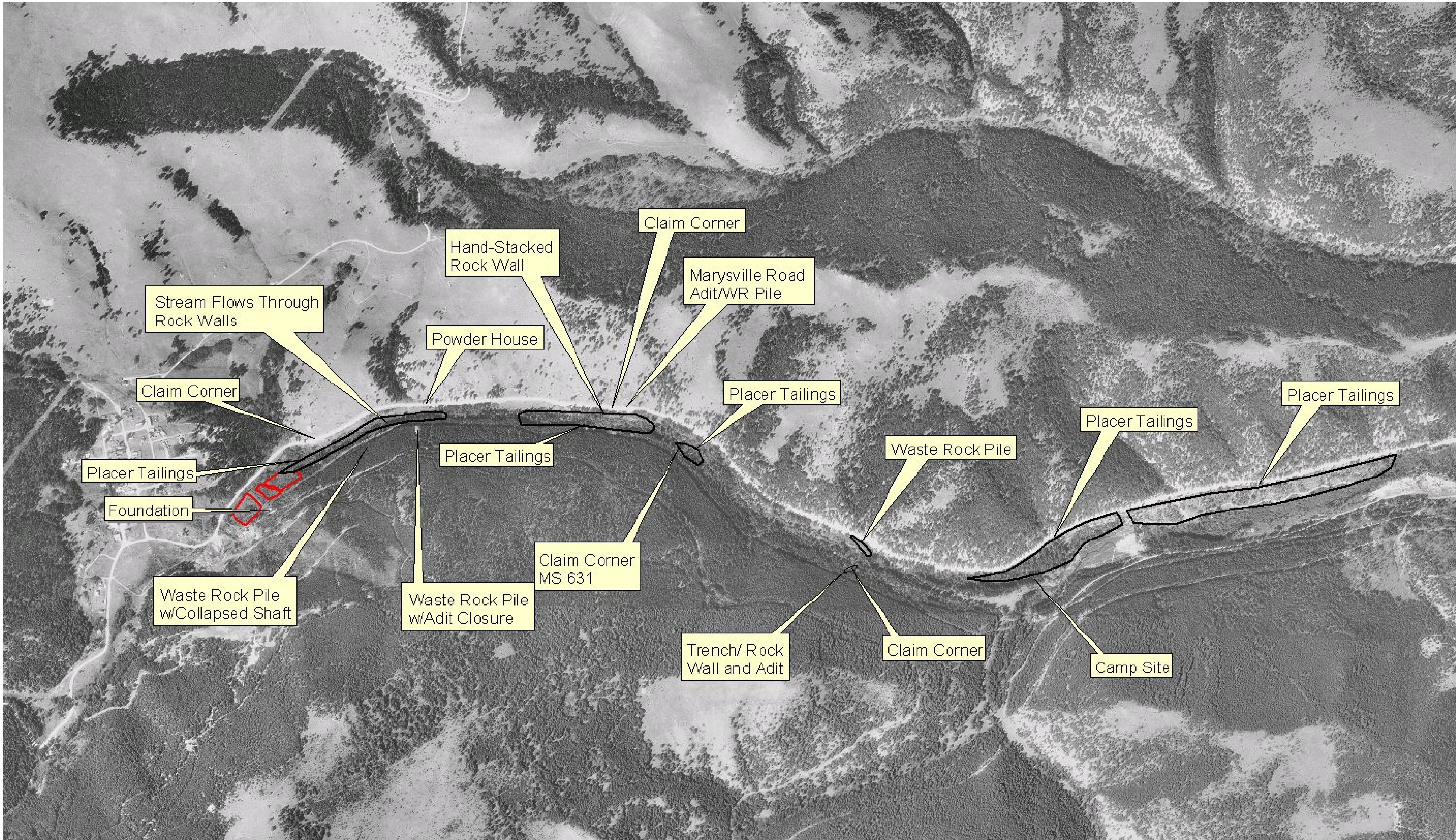
Source Type	Maximum XRF Cu+ Pb+Zn (ppm)	Minimum XRF Cu+ Pb+Zn (ppm)	Average XRF Cu+ Pb+Zn (ppm)	Median XRF Cu+ Pb+Zn (ppm)	No. Samples
Waste Rock	763	15	191.6	102	8
Drumlummon Tailings	351	25	140.8	126	31
Goldsil Tailings	1049	79	512.1	475	108
Goldsil Millsite	810	100	407.2	373	26
Upper Pond	1753	47	703.8	543	25
Middle Pond	425	43	255.3	281	18
Lower Pond	811	206	427.4	389.2	21
Stream Sediment	552	20	210.1	203	127
Borrow Source	272	0	83.1	64	11
Placer Tailings	289	0	67.9	49	35
Background	43	0	7.2	0	6

The XRF Cu+Pb+Zn concentrations for samples XRF-1, XRF-2 and XRF-3 were 660, 788 and 307 ppm, respectively. These concentrations are in the range found in the known tailings sources and are significantly above both the average and maximum concentrations found in the background, unprocessed placer tailings overburden and borrow source samples. Therefore, it is concluded that these suspected tailings sources are indeed tailings.

6.8 OTHER SILVER CREEK DRAINAGE BASIN FEATURES

Other features of interest were observed within the project area during the reconnaissance site characterization. Some of these features may be historically or culturally significant. The majority of these features were observed upstream from the Goldsil tailings area and their locations are shown on Figure 6-9. The following is a summary of these features:

- an old concrete foundation located approximately 300 feet east of the Drumlummon millsite;
- a collapsed adit south of the concrete foundation;
- a collapsed shaft and waste rock pile approximately 1,500 feet northeast of the Drumlummon mill;
- a stone building on the north side of Marysville Road reported to be a former powder house,
- several old claim corner markers;
- a closed adit and waste rock pile on the hillside south of Silver Creek and almost directly south of the powder house,
- a closed adit in the Marysville Road cut slope and corresponding waste rock pile under the road,
- a closed adit north of the Drumlummon tailings dam under Marysville Road,
- an old waste rock pile adjacent to Marysville Road;
- a rock wall, adit and trench located on the hillside south of Silver Creek and almost directly south of the waste rock pile adjacent to Marysville Road;
- an old camp site west of the Drumlummon tailings pile;
- a section of wood pipe approximately 2,000 feet long extending from behind the Goldsil millsite area to the Upper Pond (Figure 1-6);
- an old diversion headwall on Silver Creek with three parallel sections of old wood pipe extending approximately 700 feet to the Upper Pond area (Figure 1-6);
- several old dams on Silver Creek that are probably related to dredge operation (Figures 1-6 and 1-7);
- a possible mill building on the Gehring property (Figure 6-10), and



Olympus Technical Services, Inc.

0 1000 2000 Feet

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Figure 6-9. Miscellaneous Silver Creek Drainage Features

- a shallow adit in the alluvial gravels on the Talley property (Figure 1-12).

Features such as adits, shafts and pits related to the Drumlummon Mine are addressed in the Phase II site characterization report (DEQ-MWCB/Olympus, 2003).

Old concrete structures were observed approximately 300 feet east of the Drumlummon mill. The structures were observed on three separate levels. The lowest level consisted of a concrete slab. The second level consisted of a concrete slab with footings for machinery and a retaining wall. The third level had what appeared to be a concrete chute. The chute was well worn and had rebar showing through the concrete. A road passed directly above the third level. Another road from the Drumlummon mill leads directly toward the third level and, through a series of switchbacks, descends the hillside and passes below the Drumlummon mill. The road above the third level was walked several hundred feet each way and no mine openings were observed.

A collapsed shaft and waste rock pile were observed on the hillside south of Silver Creek, approximately 1500 feet northeast of the Drumlummon mill. The collapsed shaft area is approximately 15 feet in diameter and is collapsed to a depth of about 6 feet. An old wooden ladder is sticking up out of the shaft.

The powder house is located adjacent to Marysville Road and is open and easily accessible. No particular environmental issues related to the powder house building were observed.

The adit located on the hillside south of Silver Creek and almost directly south of the powder house has been previously secured with a grated culvert closure to restrict access. An old log cabin with a collapsed roof, an old dragline bucket and several broken dynamite boxes were observed near the adit. The waste rock pile is located on the hillside directly below the adit. There was no evidence of flow from the adit or seepage from the waste rock pile.

A closed adit was observed in the cut slope of the Marysville Road. The adit is partially collapsed and the opening has apparently been closed with hand-stacked rock. Directly below the adit is a waste rock pile. Marysville Road runs directly over the waste rock pile and the pile forms a small wide spot/parking area. No evidence of seepage from the adit was observed. The toe of the waste rock pile is at the edge of the Silver Creek floodplain. The area near the toe of the waste rock pile was wet and marshy; however it could not be distinguished whether the water was seeping from the waste rock pile or was related to standing water from nearby beaver ponds.

A collapsed adit was observed below Marysville Road in the cut slope of the access road to the Drumlummon tailings pile. The adit is located east of the Drumlummon tailings dam. No evidence of seepage from the adit was observed.

An old waste rock pile was observed just south of Marysville Road, approximately 2000 feet west of the intersection of Silver Creek and Sawmill Gulch. The pile is oriented approximately from northwest to southeast. The northeast end of the pile extends under Marysville Road, but no apparent workings were found in the road cut area. The pile is approximately 300 feet long, is formed along a straight axis and appears to have been placed by end dumping. An old road passes along the north edge of the waste rock pile. The pile is located outside of the immediate Silver Creek stream corridor. No evidence of seepage or significant erosion from the waste rock pile was observed.

A trench was observed directly south of the waste rock pile and on the hillside south of Silver Creek. The trench is approximately 6 feet deep and extends from near the south bank of Silver Creek up the south hillside for approximately 100 feet. A rock-walled structure was observed inside the upper end of the trench. The structure has rock walls on three sides and appears to enclose an adit that extends into the hillside perpendicular to the trench. The opening has a wood frame with a hinged wood door. The exposed opening is approximately 3-feet by 3-feet. The opening appears to have been larger, but it has been filled in. A old claim corner post was observed approximately 50 feet downslope from the adit.

An old camp site was observed approximately 200 feet west of the intersection of Silver Creek and Sawmill Gulch. Items observed at the camp included a mixture of old and relatively new items including: an outhouse near the southern bank of Silver Creek, a car axle, a wooden cable spool, old lumber and timbers and what appeared to be part of a sluice box. There are extensive, old placer workings to the north and west of the camp site.

An old wood pipeline was observed extending from behind the Goldsil millsite area to the Upper Pond area. The pipeline is approximately 2,000 feet long. The pipeline was generally intact, except for a few broken pipe sections. No evidence of tailings was observed along the pipeline or in the broken pipe sections, indicating that this may have been a water line rather than a tailings discharge line. Wooden crates were observed along the pipeline alignment, and are possibly the original packaging for shipping the pipe. The pipe is constructed of wooden slats wrapped with metal banding.

A diversion headwall and a set of three parallel sections of wood pipe were observed approximately 1,300 feet east of the lower Goldsil access road. The wood pipe is the same type as the pipeline behind the Goldsil millsite. The headwall is located on the south bank of Silver Creek and diverted water into the three wood pipes. Silver Creek flows through a series of beaver ponds upstream of the headwall area, but is funneled into a single channel by a man-made dam with a beaver dam spillway. The headwall is located downstream of the man-made dam. Remnants of a small pond (approximately 20 feet by 20 feet) and a wood-walled dam structure were observed just downstream of the headwall. The three pipes follow a straight alignment between two placer tailings piles and end at the upstream end of the Upper Pond. A second wooden diversion structure was observed downstream from the headwall/pond area. This structure had vertical wood walls and was in the shape of a "T". It appears that boards could be inserted to control the direction of flow in the "T"; however, there was no piping associated with the second diversion structure.

Several man-made dams were observed across Silver Creek and are probably related to dredge operations. The dams are all in areas where there are processed placer gravel/cobble piles and were most likely built to impound water to float a dredge. The locations include the man-made dam above the headwall, a dam near the downstream end of the Lower Pond, a dam near the upstream end of Buck Lake, the Buck Lake dam, and a dam at the pipeline crossing. Other dams for dredge ponds may have existed but could have been obscured by the numerous beaver dams and ponds along this portion of Silver Creek.

Little evidence of mining activity was observed below Birdseye Road. The only real evidence was a shallow adit in the alluvial gravels on the Talley property in the SE ¼ Section 16, Township 11 North, Range 4 West. The adit consists of a wood frame structure at the opening that is mostly covered with brush. The adit is collapsed above the wood structure. The adit is on the south side of Silver Creek and the opening is only less than 5 feet vertically above the creek elevation. A trickle of water was observed flowing from the adit opening and traveling approximately 50 feet to enter Silver Creek. No waste rock pile was observed in the area of the adit, suggesting that there were limited workings. The adit is currently not accessible should not represent a significant safety hazard.

The only other possible evidence of mining-related activity observed below Birdseye Road is a building located on the Gehring property (Figure 1-10). This area was not characterized because the land owner access agreement was not executed. A multi-tiered building with classic mill-style architecture was observed on this property from Lincoln Road. The building is located on a terrace on the south side of Silver Creek near the railroad line. Aerial photograph interpretation of Figure 1-10 indicates that there has been ground disturbance in the vicinity of the building in a linear pattern that extends toward the railroad line.

In addition to the features that Olympus observed in the Silver Creek Drainage Project area, records at the DEQ-MWCB indicate that there is a suspected tailings impoundment and buried solid waste near the Silver Fox Minor subdivision. The impoundment and solid waste were noted in a memorandum dated August 5, 1999 to the Board of County Commissioners from the Lewis and Clark County Planning Department. According to the memorandum, the subdivision is located in the South ½ of Section 6 and the North ½ of Section 7, Township 11 North, Range 4 West. A map of the proposed subdivision and the impoundment location is presented in Appendix E.

Photographs of the suspected tailings impoundment were taken by the DEQ-MWCB in August 1999 and are included in Appendix E. The DEQ-MWCB photographs and the map in Appendix E show that the impoundment is located near the railroad along the south side of Silver Creek. Based on these location descriptions, the impoundment is located just downstream of stream sediment sample SE-94. This is within the area where sampling was not completed because landowner access agreements had not been executed. The DEQ-MWCB photographs show light-colored, fined-grained material on the surface of the impoundment that could be tailings material.

A sample from the tailings impoundment was collected by the developer and analyzed for total metals in August 1999. The sample was reportedly collected from five sample holes equally proportioned across the impoundment area. The top 2.5 to 3 feet of soil were reported as a dark loam. The samples were reportedly collected from a depth of 2.5 to 3.5 feet, and they had the appearance of mill tailings. The laboratory report and a description of the sample locations are provided in Appendix E. The sample results are summarized in Table 6-6.

7.0 ASSESSMENT OF PHYSICAL HAZARDS

During the Shannon Mine reconnaissance, Olympus observed three other abandoned mines, believed to be the Ample/Hickey, Allegheny and Emma Miller (according to GIS records obtained through Montana Natural Resource Information System (NRIS)), along the Ottawa Gulch Road between the Shannon Mine and Marysville. The Emma Miller is located just on the north side of Ottawa Gulch Road. There is a small wood structure partially covering a shaft that is visible from the road. The building and shaft are enclosed by a barbed-wire fence; however, the shaft appears to be open and may, in spite of the fence, be a safety hazard. Warning signs on the fence are riddled with bullet holes and are no longer readable. Since the site is located near the main access road to this area, Olympus recommends that this site, along with the Ample/Hickey and Allegheny be further evaluated as potential safety hazards.

TABLE 6-6 TAILINGS SAMPLE RESULTS FOR THE SILVER FOX MINOR SUBDIVISION TAILINGS IMPOUNDMENT

Analyte	Concentration (mg/Kg)
Antimony	<1
Arsenic	<2
Barium	90
Cobalt	<1
Cadmium	<0.5
Chromium	3.0
Copper	8.0
Iron	11280
Mercury	<0.1
Manganese	600
Lead	<1
Nickel	4
Zinc	23

A fenced shaft was observed on the hillside northeast of the confluence of Jennies Fork and Silver Creek. The shaft is enclosed by a barbed-wire fence and warning signs. The shaft area is located on the knob of a steep hillside and does not appear to be accessed by the general public. The fence and signs should provide adequate warning of the hazard for hikers or other passersby.

8.0 POTENTIAL REPOSITORY SITE INVESTIGATION

A potential repository site is located directly south of the Lower Pond Area (Figure 6-5). The area has been previously excavated and was most likely the borrow source for the Lower Pond dam. Olympus completed a topographic survey of the potential repository area as shown on Figure 8-1 so that the volume could be estimated. A conceptual repository design was prepared to evaluate the potential volume of the repository. The conceptual repository design was based on a 5 percent repository crown slope to provide for positive drainage while allowing for settlement, and 4:1 side slopes. Based on the conceptual design shown on Figure 8-1, the potential repository area could accommodate in excess of 49,500 cubic yards of mine/mill waste. This would be enough to encapsulate the estimated volume of mill tailings from the Upper, Lower and Middle Ponds. In addition, the repository could be extended farther to the northwest into the Lower and Middle Pond areas to provide additional storage capacity.

No test pits were excavated into the potential repository area because the purpose of this project phase was reconnaissance. Similarly, no monitoring wells were installed in the repository area to evaluate groundwater conditions. Additional characterization will be required to evaluate the suitability of this repository site if it is selected for consideration.

Prismoidal Volume Results

Original Surface Model:	Existing
Final Surface Model:	Repos
Cut Compaction Factor:	0.00 %
Fill Compaction Factor:	0.00 %
Raw Cut Volume:	0 cu yd
Compacted Cut Volume:	0 cu yd
Total Cut Volume:	0 cu yd
Raw Fill Volume:	49496 cu yd
Compacted Fill Volume:	0 cu yd
Total Fill Volume:	49496 cu yd

LEGEND

- 4650 REPOSITORY INDEX CONTOUR
- REPOSITORY INTERMEDIATE CONTOUR
- 4600 EXISTING TOPOGRAPHY INDEX CONTOURS
- EXISTING TOPOGRAPHY INTERMEDIATE CONTOURS
- PRELIMINARY REPOSITORY BOUNDARY

0 50 100 150 200
SCALE IN FEET

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NO.	REVISION DESCRIPTION	BY	DATE	DESIGN:	DRAWN: KSR	CHECKED: CRS
				APPROVED:	DATE: 11/2002	JOB NO: A1284
				SCALE: AS SHOWN	FILENAME: A1284LPRepos.dwg	

MONTANA DEQ/MINE WASTE CLEANUP BUREAU
SILVER CREEK DRAINAGE PROJECT
LEWIS & CLARK COUNTY, MONTANA

Olympus Technical Services, Inc.

LOWER POND AREA
POTENTIAL REPOSITORY SITE

FIGURE
8-1

9.0 REFERENCES

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APPENDIX A

LAND ACCESS AGREEMENTS

APPENDIX B

LABORATORY ANALYTICAL RESULTS

APPENDIX C

XRF ANALYTICAL RESULTS

APPENDIX D

POTENTIAL BORROW SOURCE TEST PIT LOGS

APPENDIX E

SILVER FOX MINOR SUBDIVISION INFORMATION